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The Journal of Orthopædic Surgery

TWO UNUSUAL COMPLICATIONS IN AMPUTATION STUMPS

BY E. MUIRHEAD LITTLE, F. R. C. S., LONDON

Two cases of which I show radiographs are, I think, rare enough to be worthy of a permanent record.

CASE 1. W. M. Late R. N. D. Amputation right leg 4¼ inches below knee, left leg 5 inches below knee. Admitted to Queen Mary's Convalescent Auxiliary Hospital, Roehampton. Discharged July 30, 1918, wearing on the left stump a No. 8 artificial leg with side steels and knee joints and leather thigh corset. There is no record of the presence of any unusual condition about the knee at this time.

An X-ray picture had been taken in May, 1918, at the Pavilion Hospital, Brighton, the Commandant of which reports that nothing abnormal was then observed except a spur on the fibula.

Patient states that in August, 1918, while walking on the artificial leg he fell and hurt his knee, and the present deformity was then noticed. He suffered considerable pain, and the thigh became swollen and discoloured and remained so for a long time.

On re-admission to Roehampton in January, 1919, he showed the very striking deformity shown in the X-ray print.

The side-steels of his artificial leg were correspondingly deflected.

It will be seen that the external condyle has been fractured and driven upwards and is apparently fixed in its position by newly formed bone, and a traumatic Genu Valgum is the result.

The patient's account leaves the sequence of events doubtful, but it appears most probable that he tripped and fell and that the

fracture was caused by severe side leverage which bent the steels. In short, that the prosthesis acted as a wrench or osteoclast.

At this time, six months after the injury, it appeared unadvisable to attempt any correction of the deformity.

A new socket shaped to accommodate and compensate for the deformity was supplied, the steels, etc., adjusted, and he left the Hospital walking satisfactorily.

CASE II. W. W., late R. E. Admitted to Queen Mary's Convalescent Auxiliary Hospital, Roehampton, on March 3, 1919.

Amputation of right leg 8 inches below the knee on May 30, 1918.

Patient says, that at that time the knee was normal. He states that in October or November, 1918, when walking on crutches he fell, striking first the end of the stump and then the inner side of the knee.

An X-ray picture was taken shortly afterwards and he was told that the kneecap was broken. The knee was kept on a splint for four or five weeks.

On examination nothing abnormal was made out and neither Major Kelly of the Pavilion Hospital, Brighton, nor I could believe that the patella had been fractured in the manner described. An X-ray picture was taken, however, which is now exhibited and shows a transverse fracture of the patella at the junction of the upper third with the lower two-thirds.

In front the edges of the fragments appear to be separated by about $\frac{3}{8}$ of an inch, but they are in contact behind and appear to be united as to the posterior half of the patella by new bone.

The mechanism of this fracture is to me obscure. The patient maintains that there was no loss of the normal range of movement in the knee before the accident, which excludes shortness or adhesion of the quadriceps and shortness of the ligamentum patellae as causes.

He also denies that the knee was bent under him at the time of the fall. Although the fracture resembles the typical one caused by violent muscular contraction, (except as regards separation of fragments) it can hardly have been caused in the usual way by any effort of recovery, seeing that the leg stump was free and therefore offered no sufficient resistance to muscular action.

THE LOOP OPERATION FOR PARALYTIC EQUINO VALGUS WITH REMARKS ON THE PRINCIPLES OF OPERATIVE TREATMENT OF PARALYTIC DEFORMITIES OF THE FOOT

BY ROYAL WHITMAN, M. D., NEW YORK.

The most common of the paralytic distortions of the foot is Talipes equino valgus, caused by the loss of the Tibialis anticus muscle, often combined with complete or partial paralysis of the posticus as well.

In a characteristic case of this type the foot inclines downward and outward. The sole is everted. The head of the astragalus projects on the inner border especially when the Tibialis posticus is paralysed. The great toe is dorsiflexed in a hammer-like deformity and the head of the depressed metatarsal bone is often surmounted by a sensitive callus. The smaller toes are contracted and the salient extensor tendons are displaced outward. Dorsal flexion is restricted by a shortened tendo Achillis, and adduction by the contracted peronei and by changes in the tissues in adaptation to deformity.

The design of the loop operation is to reduce the direct abducting force by removal of the Peroneus brevis and Tertius. To increase that of dorsal flexion by transplanting the Peroneus brevis and Longus hallucis to the inner border of the foot. To lessen the tendency to deformity both directly and indirectly by displacing the dorsal tendons from the outer to the inner side of the foot, where they are retained by looping about them the tendon of the Tibialis anticus and implanting it in the tibia to serve as a supplementary support for the inner border of the foot.

The inward displacement of the dorsal tendons and the means employed to assure it are the original features of the operation.

The order of procedure is as follows: All restriction to adduction and dorsal flexion is overcome as a preliminary measure. This usually requires division of the tendo Achillis. An incision is then made behind the external mallelolus extending upward over the fibula to the junction of the lower and middle thirds. The common sheath of the Peronei is opened and the tendon of the Brevis is freed from its attachments about the malleolus. Its insertion at the base of the 5th metatarsal bone having been cut through a small incision, the tendon is drawn back and its muscular fibres

are separated from the fibula up to the point of transference. A long incision is then made over the centre of the ankle extending from about three inches above the joint downward to the metatarsal region. The tendon of the Peroneus tertius, which restricts inward displacement, is cut at its insertion and separated from the adjoining tendons of the common extensors. These tendons are carefully dissected from the underlying tissues and the annular ligament is cut through so that they may be displaced to the inner border of the foot without tension. The tendon of the Tibialis anticus is divided at its junction with the muscular substance and is drawn downward from out the sheath through a small opening near its insertion. The tendon of the Peroneus brevis is passed through the sheath of the Tibialis anticus according to the Biesalski-Mayer technique, sewed to the attachment of the Tibialis anticus and to the periosteum. The Longus hallucis tendon is cut at the same plane, drawn through an opening in its sheath, and it, together with the tendon of the Peroneus tertius, is attached to the periosteum of the scaphoid. The tendon of the Tibialis anticus is then passed from within outward under all the dorsal tendons and is drawn upward and embedded in a groove running in a direction upward and inward, cut in the inner border of the tibia after the Gallie method at a sufficient tension to hold the foot at a right angle to the leg and slightly inverted. The incisions are closed with two layers of catgut; the first for the repair of the tendon sheaths, and for a subcutaneous covering of the tendons. A plaster splint is then applied fixing the foot in the position above described.

As soon as weight bearing causes no discomfort the patient i encouraged to use the foot in walking. In hospital practice the plaster splint is continued for about three months, but if supervision may be assured, a removable support may be used which will permit exercise of the transplanted muscles in their new function as soon as repair is complete.

As has been stated, locomotion in the overcorrected position until the structure of the foot has in some degree conformed to the new relations, is an important adjunct in treatment, and it would be of advantage if the foot might be fixed in this attitude for several weeks before the operation.

By this method all the muscles of the foot except the Peroneus longus serve in some degree as adductors, and there is therefore but little tendency toward recurrence of deformity. Indeed the

overcorrected attitude is so persistent that the parents often fear a permanent substitution of the opposite distortion.

Gradually the foot resumes the normal position and later the inner side of the shoe may be thickened or a flat foot brace applied if it seems advisable, as in the cases in which the tibialis posticus is paralysed. The most important indication in after treatment is to insure the free range of dorsal flexion by methodical stretching and exercises.

It is evident that the Peroneus longus, because of its greater strength and length of tendon, is more adaptable as a dorsal flexor than the brevis. It is not transplanted, as in the conventional operation, because its normal function is important, since it binds the foot together and supports the first metatarsal bone in walking, while the Peroneus brevis and tertius are simply abductors.

I think it will appear on analysis that in the loop operation little is sacrificed in comparison with the direct gain, a conclusion that has been confirmed by practical experience.

It may be noted that it was for the relief of this deformity that tendon transplantation was revived by Parish of New York in 1892. He simply sewed the tendon of the Longus Hallucis to that of the paralysed Tibialis anticus, the result being immediate success and subsequent failure.

The original transplantation of Nicoladoni was of the Peronei to the tendo Achillis for paralytic calcaneus. This operation is still performed, although comparison of the bulk of the calf muscle with that available to replace it should indicate its practical futility, since voluntary plantar flexion is of little service unless sufficient power is restored to assure resistance in locomotion.

These and similar operations were based apparently, on the theory that a latent force might be counted on to supplement an inadequate or defective mechanical design, an assumption that has not been supported by the evidence. On the contrary the response of latent force, represented by the development of weak and inactive muscles is in direct relation to the opportunity for improved function that the operation assures. An analysis therefore of the degree and distribution of the paralysis and of the resulting disability should indicate fairly the purpose of the operation, the means best adapted for its application and the result that may be anticipated.

The function of the foot is weight bearing and locomotion. Consequently the primary object of operative repair is to assure security, and thus to displace mechanical support.

From this standpoint the relative effectiveness of the methods in common use may be considered.

Tendon transplantation can at best restore muscular balance, for which the removal of the distorting force is of equal or greater importance than the transfer of positive power.

A transplanted muscle does not increase in strength because its new function makes greater demands upon it. On the contrary, it is never as effective as in its normal position, because of the mechanical disadvantage to which it is subjected and because of the loss of a part of its muscular attachment. Thus the actual force at command, though more usefully applied is lessened rather than increased by the operation.

Since then, tendon transplantation cannot restore power but can only rearrange its distribution, it follows that it can be functionally adequate only for lateral distortion and particularly for varus deformity, because in this instance a competent dorsal flexor, the Tibialis anticus, may be changed from an adductor to an abductor without greatly lessening its mechanical efficiency.

As a comprehensive remedy therefore and especially in contrast to the claims made for it, tendon transplantation has proved unreliable and must be supplemented by other means of assuring security.

For the more severe and disabling types of deformity, especially those associated with cavus or calcaneus, the most effective basic operation is astragalectomy and backward displacement of the foot. I am obliged to use this cumbersome title to emphasize the point that simple astragalectomy is of no value whatever. The essential of success is the backward displacement so that the malleoli may overlap the medio-tarsal joint, restraining lateral distortion and preventing dorsal flexion by contact of the tarsus with the tibia. Thus the resistance of the forefoot is restored; a resistance that is essential to normal locomotion when either the calf muscle or the anterior thigh group is paralysed. Plantar flexion on the other hand is retained so that an inoffensive shoe may be adjusted to compensate for the progressive shortening of the limb that is a constant sequence of anterior poliomyelitis in childhood.

This operation has the unique distinction that the greater the deformity and disability the better, relatively speaking, is the result both from the cosmetic and functional standpoint.

Arthodesis at the ankle joint oftener results in an unstable stiffness than fixation—or if ankylosis is attained, increased mobility of the anterior articulations may permit varus deformity. In successful cases the foot is fixed at a right angle or eventually in slight dorsal flexion so that an unsightly cork sole must be worn in later years in compensation for the short limb. This, a point of greatest importance to the patient, has been quite overlooked by the advocates of the operation. From my point of view Arthodesis at this articulation is almost as unsatisfactory when successful as when it fails and I have long since discarded it.

Arthodesis at the mediotarsal or subastragaloid joints for the purpose of preventing lateral distortion is of service in the treatment of older patients but it is rarely effective in the younger class, comprising the majority of the cases, because of the large proportion of cartilage to bone. Bone pegging is simply a reinforcement of arthodesis and in its wider application it is open to the same objection.

Tendon fixation or implantation after the Gallie method is of value as an adjunct, as in the loop operation, but otherwise, in the class of cases under consideration its range of utility is very limited.

Silk ligaments: As a means of assuring permanent stability this procedure has apparently been generally abandoned and the same is true of silk tendons.

Osteotomy: Cuneiform or simple of the foot or limb may be indicated to correct deformity of long standing or to change the line of weight bearing. Fixation of the foot in an overcorrected attitude for a time sufficient to permit adaptative changes in its structure is an important adjunct in treatment. Indeed it is often far more effective than the operation which it supplements.

From this analysis it will appear that there are two procedures to which all others are subsidiary. Tendon transplantation and astragalectomy and backward displacement of the foot, the latter having by far the wider range of practical utility.

In my opinion operative treatment is indicated for all paralytic distortions of the foot and I am inclined to think that it is, at present, delayed unnecessarily. It is true that in certain types of in-

complete paralysis improvement may go on for years and that apparently lifeless muscles may revive after deformity has been corrected. If, however, a muscle or a muscle group which has properly protected shows no signs of regeneration after an interval of two years, operative treatment, if otherwise indicated, need not be delayed. It would seem furthermore that relatively early tendon transplantation should favor functional readjustment, as compared to the later period, especially if the tendon sheaths are utilized to assure freedom from adhesions.

Early operation is advisable also for paralysis of the calf muscle because atrophy and deformity advance rapidly in spite of mechanical support. In these cases astragalectomy and backward displacement of the foot is the only effective remedy, since it alone can assure the resistance necessary for normal locomotion. In this operation tendon transplantation is an adjunct—the Peronei to the tendo Achillis for calcaneo-valgus, the Tibialis anticus and occasionally the posticus to the outer border of the foot, for secondary varus.

The improvement in nutrition and strength of the limb after this operation best illustrates the response of what has been called latent force, because it is the most effective adaptation of the means at command to assure the opportunity for functional repair.

Although the operative treatment of this class of cases has been almost exclusively under orthopaedic control for more than a generation, there is as yet, if one may judge from the literature, no general agreement on its scope or purpose or upon the mechanical principles that should determine the operative design.

In view of the increasing importance of this branch of surgery it would seem that there should be a more definite standard for the guidance of prospective workers in this field, and as a contribution to this end these remarks based on personal experience, are presented for your consideration.

AMBULATORY TREATMENT OF FRACTURE OF NECK OF THE FEMUR.

BY E. H. BRADFORD, M. D., BOSTON, MASS.

Affections of the joint threatening to permanent stiffness are by general usage assigned to the charge of the orthopedic surgeon, and as the serious disability to be dreaded from fractures near the joint is a possible resulting stiffness, the services of a surgeon familiar with the use of various forms of apparatus may often be of service in joint or near joint injuries.

Fracture of the femoral neck is especially an injury to be dreaded, for it frequently leads to permanent and serious disability, not from the fracture which usually unites, nor from the deformity which at the worst does not entail great shortening or flattening of the femoral neck or twist under sensitive treatment, but from joint stiffness not easily overcome and sometimes not overcome at all. The region is not readily accessible by massage owing to the mobility of the lumbar spine; passive motion in after treatment is not effective. Patients usually past middle life are condemned to a crippled condition, with limited locomotion, after weeks and sometimes months of bed and wheel chair confinement and a long period of crutch locomotion.

It is not difficult to surmise the condition of the periarticular tissues accompanying new joint fractures or the series of changes which give rise to the stiffness in cases where no alteration in the articular surfaces of the joint has occurred and before any exostosis has been developed.

The traumatism which breaks the femoral neck will necessarily also tear or bruise adjacent ligament and fibrous tissue in the neighborhood of the joint. This is accompanied by more or less ecchymosis and infiltration of extravasated blood. In the process of healing cicatrization with development of non-elastic fibrous tissue takes place as well as the stiffening of fibrous periarticular tissue, which always follows immobility of a joint, when this is not overcome permanent joint stiffness takes place.

Weakening or atrophy of the muscles necessarily results from disuse with loss of strength necessary to permit unfatigued locomotion when the bone fragments have become sufficiently united to allow the natural weight bearing function of the bone.

The discomfort caused by the periarticular tissue changes is enough to warrant all attempts to prevent or limit their development.

An analogy can be drawn in these periarticular changes with those accompanying chronic joint arthritis with the exception that the latter are slow in development when suppurative and more extensive. Measures however which are successful in checking such tissue changes in joint disease suggest themselves as worthy of consideration in near joint fractures.

The success observed for several years at the Massachusetts Hospital State School for Cripples in the treatment of cases of hip disease, by the aid of the traction and abduction splint developed at the Boston Children's Hospital, has been so noticeable that conclusions as to its value can not well be ignored. Not only have the cases been under careful scrutiny for a long time (several years in some cases) after cure, to establish the permanency of the cure of the bone, but it was also found in many cases that permanent recovery was established with the re-establishment of joint motion, to a degree varying in extent according to the amount of tissue destruction before abduction and traction treatment was begun and periarticular ligament shrinking and stiffening checked or prevented.

With the aid of apparatus, absolute joint fixation is possible without the construction by bandage of the pelvis or trunk. The patient is able to sit up in bed even in the acuter and more painful stages. As there are no perineal straps in the appliance, there is no uncertainty in the extent of the joint fixation which is under the surgeon's control. As the acute symptoms subside the degree of fixation can be lessoned under the surgeon's direction, permitting limited and increasing joint motion diminishing ligament stiffening.

Several years ago the writer applied a traction abduction apparatus to a boy of eight with a fracture of the upper third of the femur, after three weeks' treatment in a plaster of Paris bandage. The result demonstrated the fact that a satisfactory securing of the fractured limb was possible with the use of this form of appliance. No subsequent opportunity offered itself when the application of this method of treatment seemed feasible until a year ago, when a domestic at the Hospital School for Crippled Children at Canton, Mass., fell, sustaining a fracture of the neck of the

femur. The woman was of an undetermined age, admitting that she was at least sixty-five years old and not of robust health. It was considered that prolonged recumbency and close confinement would be a severe tax upon her resistance and for a homeless woman a permanently crippled and stiffened hip, preventing any working capacity, would be a calamity. The accident was virtually a life sentence to the hospital and poor house.

The fracture was of the ordinary character of spiral fracture of the neck. There was no fissure into the joint shown in the skiagram. There was an erect upward riding of the femur with eversion of the foot. Crepitus was determined and there could be no doubt of the correctness of the diagnosis of the fracture as the case was carefully examined by Dr. Fish, the Superintendent of the School, and the resident staff, Doctors Daniels and Kemp. She was also examined by a few other competent surgeons who were at the Institution at the time of the accident, present on a meeting of Medical Advisory Draft Board held at the Institution.

On the suggestion of the writer, an abduction traction splint, a form of appliance in constant successful use in the Institution for hip disease, was made and applied to the patient as soon as it could be adjusted. During the two days necessary for the getting the splint ready, the patient was treated by means of weight and pulling traction with sand bags to steady the limb.

As soon as the apparatus was applied the patient was able to be moved about more freely in bed and two weeks after the fracture, was allowed to sit up in a chair.

The abduction traction splint held the limb firmly in an abducted position and (as verified by successive skiagram) the bone fragments in normal position.

The following dates are taken from the Hospital record and are self explanatory:

FELL, SUSTAINING FRACTURE OF THE NECK OF THE RIGHT FEMUR, FEBRUARY 18, 1918.

February 28, 1918—Patient sat up in bed.
March 7—Sat on a couch.
March 12—Stood up in a walking frame.
March 30—Walked with crutches and splint.

April 15—Traction removed, splint retained as permanent crutch.

April 30—Slept without the splint at night.

May 18—Splint taken off altogether.

June 9—Discharged from the Infirmary.

Splint taken off three months from day of fracture.

The patient left hospital for a vacation and reported again in the autumn. There was complete restoration and no shortening.

Later the patient resumed her work at the institution.

FRACTURE DISLOCATION OF HEAD OF RIGHT HUMERUS. AN UNUSUAL CASE.

CHARLES F. PAINTER, M. D., BOSTON.

Mrs. E. R., aet, 46, while coming hurriedly down stairs in a house strange to her, opened a door which led upon a pair of steps down which she fell, striking her right shoulder against a corner. She was seen by a local physician who recognized a posterior, humeral dislocation which he reduced; a subsequent X-ray showed what appeared to be a fragment of bone apparently knocked off from the greater tuberosity of the humerus. A second radiograph of the dislocation showed but little change from the findings above reported. At this point, four days subsequent to the injury, I had opportunity to see the case and had further X-rays taken stereoscopically. The radiographer reported on them provisionally, at my request, while they were still being washed, to the effect that there was an "egg-shell" fracture of the greater tuberosity with a slight displacement of the head of the humerus backward. When the plates were dried, however, the head of the bone was found to be located well down in the axilla rather posterior to the mid-axillary line and certainly 3½ to 4 inches below the upper end of the humerus.

Under ether at the time of operation undertaken for its removal the head of the bone was vaguely palpable in the lower part of the

axillary space. Through an incision about 10 cm. in length started at about 2 cm. above the reflection of the skin of the arm over to the chest when the arm was extended horizontally, the inferior border of the pectoralis major was exposed and the dissection carried bluntly until the brachial artery, nerve and vein came into view. Down behind the vessels the bone could be felt but as it was too risky to try and extract it directly past these structures, so the incision was lengthened both ways and the bone approached from behind, being freed of its connections by finger dissection. The head was delivered intact and showed that the line of cleavage had been directly across the anatomical neck of the bone with very little more roughness of the fractured surface than there would have been had the break been caused by a sharp instrument. The upper end of the humerus was left in contact with the glenoid and later passive motion and massage will be instituted to restore as much as possible the motion at the shoulder joint. The excision of the head could not have been more satisfactorily done had it been formally performed by a master of the surgical technique of this region. The accompanying X-ray shows the relation of the fragment to the rest of the bone and gives a good representation of this rather unique, in my experience at least, accident. The problem of restoring the head of the humerus to its proper place and attaching it there so it would stay seemed to present serious obstacles and the probability that the functional results which might be attained if successful in the technique of restoring the parts to their proper relations would not be better, if as good, as those following a formal excision of the head of the humerus when done for any pathological condition. Accordingly this was the procedure followed. Satisfactory functional result is expected.

CHRONIC SEPTIC INFLAMMATION IN BONE FOLLOWING GUNSHOT WOUND.

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The medical history of this war will show that one of the most difficult problems with which surgeons have had to deal has been the treatment of chronic osteomyelitis secondary to gunshot wounds. That the treatment of this condition has been notoriously unsatisfactory in the past is witnessed by the great variety of treatments that have been advocated, each having its vogue for a few months or years, only to be abandoned because of its failure to accomplish the claims of its originator. The difficulty always has been that in spite of the treatment, a high percentage of the cases did not heal, or if they did heal, repeatedly broke down, leaving sinuses communicating with cavities in the interior of the bones. Sometimes these sinuses have persisted for years with a constant slight purulent discharge and other signs of deep-seated inflammation. At other times they have healed spontaneously, only to recur years afterwards, following the onset of symptoms of acute osteomyelitis. The writer recently had occasion to operate on a soldier who had been wounded in the North-West Rebellion in 1885. His wound consisted of a compound fracture of the middle third of the femur produced by a rifle-ball. Chronic osteomyelitis had persisted for several years, during which time several sequestra had been evacuated. The sinus finally healed, and no trouble developed until a week or so previous to admission to the Military Hospital, when he began to suffer from intense deep-seated pain, with fever and malaise. At operation a drill was passed through very sclerotic bone into a cavity the size of a chestnut, filled with thick pus, and further exploration showed the presence of a shell-like sequestrum.

The usual primary treatment of osteomyelitis has consisted simply of incision and drainage. After the lapse of three or four months, by which time any necrosed bone has become separated, the sinus is enlarged, the sequestrum removed, and the operation completed by curetting the cavity and the sinus and packing the wound with gauze. In the majority of cases this treatment has sufficed, the sinus healing in four, five, or six months, sometimes after the spontaneous discharge of additional spicules of necrotic

bone, or after repeated curettings of the cavity and sinus. Certainly great numbers of soldiers are passing through our base hospitals who apparently have been cured of discharging sinuses by this means.

The Antiseptic Method.

A large proportion of cases, however, have not responded to this simple procedure, and as a result, there has been for many years a search for some method that would materially reduce the percentage of failures. With the introduction of antiseptic surgery the hopes of investigators were raised by the possibility of completely sterilizing the cavities by the use of powerful antiseptics. It became a favourite treatment to open the cavity widely, to clean it thoroughly out with curette and chisel, and to make application of a strong solution of chloride of zinc, or pure carbolic acid followed by alcohol, leaving a tube or gauze-wick for drainage. While occasional good results have been recorded for this method, it cannot be said that it has any decided advantage over the simpler procedure, and in many cases it has undoubtedly done harm by causing a superficial necrosis with subsequent formation of sequestra. The search for an antiseptic which would secure the sterilization of the cavity without injurious effect on the tissues has gone on steadily up to the present day, and there are some writers who are advocating a treatment similar to the above, substituting for the corrosive such antiseptics as eusol, flavine or Dakin's solution. We have given these various methods a fair trial but have been unable to convince ourselves that there is any particular advantage in any of them, or that the use of any antiseptic materially influences the course of the disease.

The Sterile Blood-clot Method.

Based on the observation of Lister, that when cavities are produced subperiosteally in the bones of animals, and are allowed to fill with sterile blood-clot, the clot rapidly undergoes organization, and in the course of two or three months is converted into new bone, several writers, of whom the chief is Halstead, have advocated the careful sterilization of the cavity with strong antiseptic, and the immediate suture of periosteum, muscles and skin, after which the tourniquet is removed and the cavity allowed to fill with blood. Undoubtedly brilliant results have occasionally followed this treatment, the wound healing by primary union and a com-

plete cure resulting. But in the majority of instances the attempt has ended more or less disastrously owing to the profuse suppuration of the wound, and the spread of necrosis in the bone, resulting from the inadequate drainage. It does not appear to be reasonable to expect to secure the perfect sterilization of such cavities by any of the means at our disposal; and without perfect sterility, particularly after the use of antiseptics so strong as to produce superficial necrosis, any attempt to obtain primary union of the wound must be attended by a risk which is out of proportion to the benefit to be obtained.

Other and More Recent Methods.

A modification of the above method has recently been advocated and a number of successes recorded. Instead of treating the wound with strong antiseptic after the thorough removal of scar, sequestra and diseased bone, the area is lightly smeared with the bismuth-iodoform-paraffin paste of Morison, and the wound closed about a narrow rubber drain which is removed after forty-eight hours. Thus the principle of the sterile blood-clot has been eliminated, and the hope of a cure is based altogether on the sterilty of the cavity or on the low virulence of the organisms retained. This treatment is a decided improvement on the method of Halstead as the blood-clot which is so apt to become septic is drained away, and even if the wound does suppurate the presence of the small drain reduces the spread of necrosis in the bone. This method has been successful particularly in those cases in which it was possible to remove the walls of the cavity so widely that the surrounding soft tissues were able to fall into it and so obliterate a space in which fluid could collect. It must be recorded, however, that failures after this operation are frequent, chiefly because of suppuration and inadequate drainage. We have at present no dependable method of foretelling which cases are suitable for secondary suture. The method recently popularized by Carrel, of choosing for secondary suture those cases of superficial wounds which have closely approached sterility, as shown by the bacterial count in smears, is not applicable to septic cavities in bone, as here we have a condition which prevents the preliminary sterilization of the wound. The operation is therefore not likely to reach any degree of popularity, and must be considered for the majority of cases too risky a procedure to be justifiable.

Believing that the explanation of failures in the treatment of chronic osteomyelitis is to be found in the persistence of a non-collapsible cavity, many surgeons have advocated sterilizing the cavity as far as possible, and filling it with absorbable or non-absorbable materials. Thus Hamilton experimented with sponges, filling cavities in the bones of animals with this material, and immediately closing the periosteum and the superficial wound. Microscopic examination at intervals showed the gradual absorption and replacement of the sponge by new bone, and it was said that the process occurred more rapidly than where no sponge was used in the cavity. The principle was then applied to septic cavities after an attempt at sterilization, but the results have not been good. There was the same occasional success with frequent disastrous failures as in the treatments just described. Similarly, other surgeons have used iodoform gauze, antiseptic cotton, such as was formerly used and abandoned by the dentists, catgut, and many other organic substances, and the results were much the same. None of these methods ever attained popularity.

Much the same opinion has developed in regard to those methods which have depended on the obliteration of the cavity by fragments of bone, bone-dust, or the decalcified bone-chips of Senn. The use of such materials was suggested by the fact that when fragments of dead or recently obtained autogenous bone were inserted into sterile cavities in the bones of animals they acted as a scaffold, through which a circulation rapidly became re-established, and were invaded by osteoblasts which absorbed and ultimately replaced them with new bone. Senn decalcified the chips in order that he might pack the cavity more tightly. The use of such materials, however, meets with exactly the same difficulty as confronted the use of sponge, etc., namely, the presence of sepsis in the cavity. Nobody dreams of putting a bone-graft into a case of ununited fracture unless perfect asepsis is assured, and many months are allowed to elapse after the final healing of the wound before such an operation is attempted. The results of the treatment were exactly what might be expected. Occasionally an operation was followed by brilliant success, but in the majority the wounds became septic and had to be opened up and cleaned out according to the general principles governing the treatment of suppuration.

In order to prevent the suppuration which so frequently follows

the introduction of foreign materials into septic cavities, many varieties of antiseptic pastes, gums and wax have been employed. Of these the most widely known is the compound of iodoform, oil of sesame, and spermaceti, advocated by von Mosetig Moorhof. This writer, in 1906, reported a large number of cases treated by this method, with uniformly good results. Such results unfortunately have not been obtained by others and the method is now very seldom used. There has recently been a revival of the search for a suitable antiseptic substance with which to fill the cavity, and some good results have been reported after the use of Beck's bismuth and vaseline paste, and also the so-called B.I.P.P., so strongly advocated by Rutherford Morison in the treatment of wounds. Our experience with these materials has not been satisfactory. Some years ago a series of sinuses leading to bone cavities which had been cleared of sequestra, were injected with Beck's paste. In one case the sinus did heal after several weeks, in fifteen others nothing happened that could be attributed to the treatment, and in three it was necessary to open up the sinus more widely because of interference with the drainage. Our experience with B.I.P.P. has consisted chiefly in operating to remove it from cavities which had been filled with the compound previous to admission to this hospital. The cases usually presented a small sinus with no surrounding inflammation, from which a slight sero-purulent discharge had persisted for months.

The "Flap" Method.

In the last few months several writers have suggested a new principle in the treatment of these cavities which appears to be a considerable advance on the methods already outlined. It has been observed that when the walls of the cavities had been widely removed so that the soft tissues were able to fall into the depression, the wounds healed much more rapidly than where a definite cavity persisted. This suggested the idea of filling cavities which could not be converted into shelving depressions, with pedunculated flaps of fat or muscle. By this means healthy living tissue was introduced, which could not have the disadvantages of the foreign materials. We have given this suggestion a thorough trial and have been very favorably impressed with it. Healing occurs in these cases with greatly increased rapidity. In order that we might study the sequence of the changes more carefully, the flaps were

arranged in several cases so that they could be inspected daily through the superficial part of the wound. After the lapse of three days the flaps are covered with healthy granulations which unite with those which are sprouting from the bones and so assist in obliterating the cavity. The flap assists, therefore, in two ways, first, by reducing by its own bulk the space to be filled by granulation tissue, and second, by acting as a centre from which healthy granulations can grow. It is only in the very large cavities that such an expedient is necessary, as the smaller cavities will heal very nicely without it. It is in the former, however, that one is so apt to see the process of healing by granulations cease after a few weeks, owing to the contraction of deep scar, and in these cases the presence of a core of healthy muscle or fascia is of great value in completing the closure of the wound.

Personal Studies.

In the routine of a study of the repair of bone, some of the experimental studies above referred to, upon which the various forms of treatment were based, were repeated by the writer in conjunction with D. E. Robertson, of Toronto, and some important variations in the results observed. Thus, a series of experiments was performed as described by Lister, in which small fragments were removed subperiosteally from the radii of dogs, and after the periosteal tube had been restored, the cavity allowed to fill with blood-clot. The specimens were recovered at intervals of a week and showed the organization of the clot and its replacement by new bone as described in the original experiment. When the operation was modified, however, by the removal of the periosteum with the fragment of bone, so that no periosteal tube could be restored, and no sterile blood-clot retained, the changes observed in the cavity in the succeeding weeks were practically identical with those described by Lister. The cavity became filled with granulation tissue which grew from the cut surface of the bone, and in the course of eight or ten weeks was replaced by cancellous tissue which gradually increased in density until the normal structure was restored. The obvious conclusion is that blood-clot is of no particular value, even in aseptic wounds, in inducing more rapid filling of the cavities.

In another series of experiments the cavities were filled with sponge, gauze and silk, as described by Hamilton. The results

failed to show that the cavities did fill with new bone more quickly than when they were allowed to fill with blood-clot over which the periosteum had been sutured, or which were simply allowed to granulate from the bottom without the presence of blood-clot.

In both the above groups of experiments, however, an observation was made which is of practical importance. When the fragments were cut from the shafts of the bones, in such a way that they consisted of compact tissue only, the filling of the cavity was very slow as compared with those cases in which the cavity extended to the deep cancellous tissue or the medullary cavity. In the latter the whole excavation became filled within a week with new capillaries and proliferating osteoblasts which could be seen flowing out of the deep portions of the bones. Within two weeks the whole cavity was occupied by a mesh-work of cancellous tissue. This observation is confirmed by other experiments with autogenous bone-grafts in which the bone was transplanted into the muscles of the back. New bone formation always occurred on the surfaces of the graft but was practically confined to the endosteal and periosteal surfaces, and did not appear until late on the cut ends. As pointed out in previous publications, this is due to the presence of free osteoblasts on the endosteal and periosteal surfaces and to their comparative scarcity on the cut ends. This observation is of practical importance in that it indicates the necessity for free chiseling in those cases of old chronic cavities in which the walls have become sclerosed. Fortunately such a condition only occurs in neglected cases, as the walls of cavities which contain sequestra are usually in a state of osteoporosis, a condition which is most favorable to the pouring out of osteoblasts and to new bone formation.

In a third series of experiments the effect of filling aseptic cavities with non-absorbable pastes was studied. Cavities were produced subperiosteally as already described, and filled with molten paraffin, over which the periosteum was carefully closed. The specimens were recovered at intervals up to ten weeks and showed several interesting points. In no case did new bone appear between the paraffin and the periosteum, thus confirming Macewen's contention that the periosteum is only a fibrous membrane and not osteogenetic. Several writers have criticized this experiment, maintaining that foreign materials introduced beneath the periosteum may act as a preventive of osteogenesis. This criticism is

answered by a further examination of the specimens which show that where the cavity has extended to the medullary cavity, the paraffin has become covered with new cancellous tissue which in the older specimens has been converted into compact bone. The only explanation of the difference between the reaction of the periosteum and the medullary tissues to the stimulus of the operation must be that in the case of the reflected periosteum no osteoblasts were present on its deep surface. This view has been confirmed by many other experiments, elsewhere described. These experiments were of further interest in showing the re-arrangement of the structure of the shaft of the bone, in accordance with Wolff's law, to overcome the decrease in strength resulting from the production of a permanent cavity. All the surrounding bone became increased in thickness and in density so that after the lapse of three months, one might say that the shaft was as strong as before the operation.

In this experimental study the methods of Senn and others who sought to close septic cavities by filling them with fragments of bone were investigated. When fragments of autogenous bone are placed in one of the muscles, those cells which are exposed on the surfaces to a supply of lymph immediately proliferate, and in the course of eight or ten days begin to produce new bone. If several fragments are in contact they soon become cemented into one mass by this new cancellous tissue. The transplants themselves become necrotic owing to the absence of a blood and lymph circulation in the minute osseous canals, and as a result the cells in the lacunæ die and ultimately disappear. In the course of a week new blood-vessels grow into the old Haversian canals, and along with them go many osteoblasts which immediately become engaged in the absorption of the necrotic bone. As the old bone disappears, its place is taken by new bone laid down by these osteoblasts, so that after the lapse of two or three months all traces of the old fragments have disappeared and the mass consists entirely of new cancellous tissue. When such fragments are introduced into aseptic cavities in the radii of dogs the same process occurs with even greater rapidity, as there is now an additional supply of living osteoblasts from the exposed walls. No more effective method could be devised of encouraging the filling of aseptic cavities with bone than by using fragmented autogenous transplants. To a certain extent, also, heterogenous and boiled bone fragments are of

value. Although heterogenous and boiled bone, when implanted in living tissues, contain no living cells and are therefore quite devoid of osteogenetic power, they act as an irritant to the surrounding living bone of the cavity wall, stimulating it to osteogenetic activity, and keeping it in this condition for several months, until all the dead bone has been absorbed. In addition, the dead bone, by means of its Haversian canals, provides a scaffold in the same way as does autogenous bone, for the spread of new blood-capillaries and osteoblasts from the surfaces. These osteoblasts immediately become engaged in the absorption and replacement of the implants, with the ultimate result that the cavity is occupied by cancellous new bone. The only appreciable difference between the effects produced by autogenous and heterogenous or boiled bone, is that in the former the whole process is more rapid.

The Infected Bone Wound.

But while such experiments are interesting in showing the effect of such procedures on the normal physiology of bone, they are of little value in leading to a solution of the problem of the closure of the cavities associated with osteomyelitis. Here we are confronted with the additional factor of bacterial infection which completely changes the sequence of events. If any method could be devised of completely sterilizing the cavities, no doubt the same series of changes would occur, with the same gratifying results. But up to the present the weight of clinical experience has gone to show that no certain method of sterilization has yet been discovered, and although occasional successes have led investigators to hope that the problem has been solved, further experience has always led to disappointment. Not only do these methods of filling the cavities with foreign materials fail, in the great majority of cases, to accomplish a cure of the sinus, but they actually constitute a source of real danger in interfering with the free drainage of the wound.

Another fallacy into which one is apt to fall, as a result of depending too much upon experiments on small animals, is that because one finds that small cavities in such bones as the radii of dogs fill readily with bone, one should expect the large cavities resulting from necrosis and osteomyelitis to fill with bone in a similar fashion. Small cavities undoubtedly do fill with cancellous bone, with the ultimate complete restoration of the normal struc-

ture, but it is common experience that large cavities often granulate up from the bottom and finally heal without any marked attempt at new bone formation, and examination of these cases months afterwards with the X-ray shows the persistence of a cavity in the bone. Such cavities are filled with a solid mass of white fibrous tissue, surrounding which is a wall of compact bone, of a density similar to normal cortex. In all probability as the years go on, such cavities will gradually disappear in obedience to the law of growth, but the observation goes to show that the cure of cavities in bone does not depend on the immediate restoration of the normal structure by the laying down of new cancellous tissue.

It would therefore appear that the problem consists of getting these cavities filled with living tissue of any kind, at the earliest possible moment. In the face of the presence of infection this demands the establishment of perfect drainage. Any pocketing of pus will result in retarding the growth of granulations. The more such cavities are opened up and exposed to the air, the better will the granulations grow and the more rapidly will the cavity disappear. In this relation, also, the suggestion that the walls of the cavities should be so widely removed as to allow the soft tissues to fall into them is of importance. By so doing the size of the space to be filled is reduced, and an excellent source of healthy granulations is provided. The suggestion already mentioned, that deep cavities should be partially filled with pedunculated flaps of fascia or muscle, is quite in accord with this principle. Fortunately, the vitality of such tissues is not interfered with by the presence of mild infection.

In the series of experiments above referred to, the fate of such flaps has been studied. Both in patients and in animals, grooves and tunnels have been made in the bones, subperiosteally, and the cavities produced filled with tendon, muscle and fascia, over which the periosteum was sutured. The specimens were observed in the case of the patients, at a second operation, and in the case of the animals, at autopsy, at intervals of from two months to several years. In each case the muscle, tendon or fascia was firmly united to the bone by fibrous tissue; the groove or tunnel still persisted as at the time of the operation; and the bone surrounding the implanted soft tissue had thickened and increased in density sufficiently to restore the normal degree of strength. A point of special

interest in these specimens was that in no case had bone appeared between the periosteum and the implanted tissue.

The anatomical and pathological considerations upon which the treatment of chronic osteomyelitis at the Military Orthopædis Hospital, Toronto, and the Granville Canadian Special Hospital, Buxton, is based, can be reviewed briefly.

The shaft of a long bone consists of periosteum, compact and cancellous bone, and marrow. The periosteum is a fibrous membrane in which the blood-vessels to the superficial layers of the bone ramify before entering the Haversian canals, and through which pass the large nutrient vessels on their way to the medullary cavity. It therefore follows that stripping of the periosteum will interfere more or less seriously with the circulation in the bone, depending on the size and the number of the blood-vessels destroyed. When this occurs in an aseptic field, as in simple fractures, or during clean operations, or in compound fractures that do not become infected, no gross disturbance results, and it has been customary to suppose that no important pathological change has occurred in the portions of bone so denuded of periosteum. That this is an error is witnessed by the fact that the rapidity of union of simple fractures is frequently inversely proportional to their severity; that union following operations on simple fractures, in which the periosteum at the ends of the fragments has been extensively reflected, and plates or wires inserted, is often greatly delayed; and by the observations of Robertson and the writer that following the stripping of the periosteum over even small areas of the shafts of the bones of animals, coagulation of the blood in the Haversian canals occurs to a considerable depth, and the lacunar cells which derived their nutrition from these blood-vessels become necrotic and slowly disappear. This superficial necrosis is by no means extensive and usually gives rise to no clinical symptoms, as the circulation rapidly becomes re-established and the necrotic bone is quickly absorbed and replaced by normal bone.

Very different is the fate of similar necrotic areas of bone in the presence of sepsis. In this condition no re-establishment of the circulation takes place, and no invasion by osteoblasts from the neighboring living bone. If the drainage of pus is sufficiently free to allow the acute inflammation to subside and so terminate the spread of the destruction of the circulation, the residual septic irritation along the edges of the necrotic bone stimulates the osteo-

blasts in the surrounding living tissue to greatly increased activity, with the result that absorption of the living bone takes place until a zone is produced about the dead bone which is occupied only by granulation tissue, which, by a process of ulceration on the surface next the sequestrum, undergoes liquefaction, and so allows the latter to become free. Here it remains for months or years unless extruded by muscular action or removed at operation. By keeping up a constant irritation and by harboring a mild infection it usually prevents the healing of the sinus, or, if healing does occur, causes recurring attacks of more acute inflammation.

Both in the case of aseptic necrosis produced by disturbance of the periosteum and of septic necrosis produced by the spread of infection or by destruction of the circulation by mechanical means, coincident with the introduction of infection, changes of great importance occur on the surface of the necrosed area. On the surface of the bone, particularly in young animals, are many osteoblasts which were formerly supposed to belong anatomically to the periosteum, but which have been shown by Macewen, many other writers and ourselves, to be more properly classified as belonging to the bone. Whenever necrosis occurs in the underlying bone, without the accompanying destruction of these cells, they are immediately stimulated to activity, as are all osteoblasts in the neighbourhood of the necrotic tissue. Thus, when the periosteum has been stripped from an area of the shaft of the radius of a dog, under aseptic precautions, and either sutured back in its former position, or completely removed, these cells, which during such manipulation remain on the surface and in the irregularities of the surface of the bone, undergo rapid proliferation, and soon form a layer of cancellous tissue. In septic necrosis, if the infection is very virulent, or the evacuation of the pus long delayed, these superficial osteoblasts also undergo necrosis and no such new bone formation occurs. This is sometimes seen in cases of acute idiopathic osteomyelitis in children, the whole length of the shaft of the bone being destroyed, and no evidence of regeneration ever appearing. In the majority of cases, however, many of these cells survive, and after the acute inflammation has subsided, undergo rapid proliferation under the influence of the irritation of the underlying necrotic tissue and the mild infection. Some of the cells which are farthest removed from the source of irritation, that is, those that are most superficially placed, and which are there-

fore in closest relation to the periosteum, begin to produce new bone, and before long the whole surface of the sequestrum, except opposite one or two cloacæ through which drainage takes place, becomes covered with a thick layer of spongy bone called the involucrum. Between the involucrum and the sequestrum there persists the same zone filled with granulation tissue, the inner surface of which is in a state of ulceration, as occurs at the line of demarcation. This appearance of a layer of new bone subjacent to and attached to the periosteum has been one of the strongest arguments in favor of the theory that the periosteum is osteogenetic.

In addition to the changes described as occurring in the immediate neighbourhood of areas of necrosis, the whole of the neighboring bone within a radius of several inches may undergo inflammatory change. In the case of aseptic necrosis such as that produced by cutting out a piece of bone and then replacing it, this is slight, and cannot be detected beyond a distance of half an inch from the edge of the dead bone. But in osteomyelitis it may involve the whole of the remainder of the shaft, depending on the extent of the original necrosis. Thus, rarefying osteitis extending a long distance from the necrotic focus can be demonstrated, and the whole shaft over such areas becomes thickened by the deposit of spongy new bone. It is very evident, therefore, that mild septic infection is the greatest stimulant to bone repair. This is demonstrated clinically by the great masses of new bone that form in relation to septic compound fractures and by the spurs and irregular masses which develop at the ends of the septic stumps.

Another pathological change of great importance often occurs in these cases of chronic osteomyelitis, after the irritant has been removed. The osteoblasts which have been enormously increased in number throughout the whole of the inflamed area have hitherto been employed in the rarefaction of the neighbouring bones. They now revert to their adult function of bone-production, with the result that previously soft cancellous and vascular bone becomes exceedingly hard, compact, and correspondingly anæmic. Thus, a cavity left in the shaft of a bone after the removal of the sequestra may gradually have its walls changed from soft cancellous bone to bone of flinty hardness, and the change from vascularity to anæmia in the walls has a great deal to do with the small tendency that such cavities have to heal. Similarly, after the evacuation of sequestra from septic non-unions, the ends of the bones may become so in-

tensely sclerotic that there is little tendency to union after any form of operation, the reason being that the outpouring of osteoblasts from the ends of the fragments is so slight that bony repair cannot successfully bridge the gap, and the space fills again with fibrous tissue.

The role of the marrow in the growth and repair of bone seems to be much the same as that of the periosteum. It does not contain many osteoblasts, these being confined to the layer of cells known as the endosteum, which lines the irregularities of the medullary surface. Its function, considered surgically, consists in acting as a medium for the distribution of the blood-vessels to the Haversian canals of the deep portions of the bone. It follows therefore that damage to the circulation in the marrow will produce changes in the deep layers of the bone similar to those already described in the subperiosteal layers, after destruction of the circulation in this locality. We have recently been able to demonstrate such changes in a case of acute hæmorrhagic infantile scurvy in which the stripping of the periosteum of the tibia involved its nutrient arteries. Sections of the bone made three months afterwards showed the deep layers of the bone, as well as the superficial, to be necrotic, the cells having disappeared from the lacunæ, and the bone undergoing absorption and replacement by cells which had invaded it along with blood-vessels from neighboring living tissue.

Clinically we see a demonstration of these fundamentals in the character of the sequestra which result from various types of wounds. Thus, in compound fractures and in amputations in which there has been acute infection, more particularly if drainage has not been provided early, one is apt to find sequestra form at the expense of the medullary surface of the shaft, indicating the spread of infection and destruction of the circulation in the marrow. All are familiar with the cone-like, tapering sequestra that can sometimes be pulled out of the ends of the septic stumps. On the other hand, in those cases in which stripping of the periosteum has been a feature of the condition, such as in acute idiopathic osteomyelitis, or in operations on the long bones in which the periosteum has been freely reflected and sepsis has been present or has supervened, the sequestra always consist of flakes separating from the periosteal surface of the bone. As in the case of the tubular sequestra which often separate from the medullary surface of stumps that have been septic, we are quite familiar with the circular sequestra

which are pulled off the outer surface of the ends of bones from which the periosteum has been reflected during the operation.

THE PRINCIPLES OF TREATMENT.

From the above considerations may be drawn certain conclusions which may be used as a basis for establishing principles of treatment. We know that healing never occurs in the presence of septic necrotic bone. Therefore every effort should be made to prevent the development of necrosis, and if this misfortune has already occurred, to get rid of the sequestra at the earliest possible moment. As pointed out above, necrosis results from destruction of the circulation to portions of the bone, either produced mechanically or by the spread of sepsis. As a preventive of necrosis, therefore, in cases that have been infected, or which may have been infected, it is of the utmost importance that free drainage be provided. It is just here that those treatments which aims at a cure of chronic suppuration by the sterilization of the field, followed by closure of the wound, with or without the use of foreign materials to fill the cavity, fail. When suppuration occurs, as is very frequently the case, the back pressure is sufficient to produce a further spread of necrosis, and complete failure is the result. Another two or three months must elapse before the new sequestra separate and before the patient is ready for another attempt at a cure.

In those cases in which necrosis has already occurred after an acute infection, no treatment is possible until the sequestrum has separated, further than to provide for efficient drainage. Those surgeons who have fondly hoped that by an extensive subperiosteal resection, the whole of the diseased area could be removed as soon as the acute sepsis had subsided, and that the shaft would be restored by regeneration from the periosteum, have, in the majority of instances, been rewarded by a persistent non-union, there being no effort at restoration of the shaft except at the extremities of the fragments. This idea was based on the faulty premise that the periosteum is osteogenetic, a theory which has been amply disproved by experiment, and by the frequency of the disastrous results that have followed its clinical application. If one closely examines the reports of the cases in which claim has been made that restoration of the shaft has followed extensive subperiosteal resection, it will be found that, as a rule, the operation was performed after sufficient time had elapsed for marked proliferation

of the subperiosteal osteoblasts to have occurred, and usually for the formation of involucrum to be well established. Under such circumstances restoration may sometimes occur owing to reflection of these osteoblasts and new spongy bone with the periosteum. Even such operations as these, however, have nothing to recommend them, as no time is saved, and the danger of non-union and deformity is very great. In our teaching, the operation of subperiosteal resection, both immediate and delayed, is strongly condemned.

When once the sequestrum has become completely separated—a process which occupied approximately three months—radical treatment is urgently called for. This is the time when the reparative process in the bone is at its greatest height. The whole area is in a state of rarefying osteitis, with actively proliferating osteoblasts and blood-vessels, and with rapidly growing spongy bone on the surfaces. Further, the treatment must be such that the healing of the cavity shall be complete before the onset of sclerosis in the bone surrounding the cavity shall have advanced sufficiently far to interfere with the vitality of the growing granulation tissue.

In the majority of instances a cure results from the removal of the sequestrum or from the removal of the sequestrum plus a curetting of the cavity. In many cases, however, this is not sufficient, the sinus persisting indefinitely, and as the months go on, becoming more and more difficult to cure. This is sometimes due to the incomplete removal of the sequestra, sometimes to insufficient drainage, and sometimes to the great size of the rigid walled cavity which makes it impossible for the granulation tissue to completely fill it, owing to the anæmia of the surface granulations produced by the contraction of the deep scar. In our experience the frequency of these causes is in the order named.

To make sure of the complete removal of the sequestra it is necessary that the whole of the cavity shall be explored, and this means that it must be clearly seen. To accomplish this, the whole wall of the cavity nearest the incision must be removed with chisel and mallet. When this is done one is often surprised to find the great extent and irregularity of the cavity, and it is readily seen how simple curetting would usually fail to get out all the dead bone. The utmost care is taken to avoid disturbing the periosteum. This is neither reflected from the bone nor are the soft tissues reflected from the periosteum more than is absolutely essential, otherwise

superficial scales of necrosis are sure to form and lead to persistent discharge. The chisel is applied to the outer surface of the periosteum and the wall of the cavity cut out cleanly. This same principle is applied to the re-amputation of stumps where infection of the wound is a possibility. Without a doubt, reflection of the periosteum would cause no harm if the whole of the bone underlying the area reflected were cleanly chiseled out, but it is difficult to accomplish this and it is better avoided. Since we have taken these precautions we have never had a sequestrum develop after operation.

To reduce the size of the cavity to a minimum and to allow it to fill with normal soft tissues as far as possible, the incision is extended through normal skin and muscle in both directions and the chisel again applied so as to convert the cavity into a crater or a simple depression. In this way, half the thickness of the femur, tibia, or humerus, is sometimes removed over a distance of six inches or more. Every crevice, pocket or tunnel is freely opened up until the whole cavity is converted into a more or less smooth depression and every particle of loose bone removed. The tourniquet is then removed and hæmorrhage controlled by clamp, ligature and pressure.

We believe the greatest importance should be attached to the method of closure and the treatment of the wound. Recognizing that insufficient drainage is the cause of most disasters and failures following such operations, we make it a point to leave very large openings for drainage. The fascia and skin are closed at the extremities with silk-worm gut and practically always heal by primary union. The central portion is left widely open, however, so that the whole cavity can be inspected from the surface. If muscles and fascia tend to close together over the opening, unless the cavity is a very shelving depression, the transverse diameter of the wound is freely enlarged by making a wide window through the muscle and fascia and by cutting a similar opening in the skin. Often this is unnecessary in subcutaneous bones, as the excision of the scar to the periosteum leaves a sufficiently wide area exposed. We have a rough rule that the diameter of the drainage wound at its narrowest point shall be equal to half the depth of the bottom of the cavity. By this precaution we are able to inspect the bottom of the wound during the daily dressings, the whole cavity is exposed to the air like an ordinary superficial healing ulcer, and no pocket-

ing of pus, the sure precursor of complications, is possible. Time and time again we have seen operations performed as above, except that the wound was closed around a quarter or half inch rubber tube or a wick of gauze, end in failure or long-delayed healing owing to the premature closure of the sinus, with a resulting pocketing of discharges. Before the application of the dressings the cavity and outlet are packed with iodoform gauze to prevent hæmorrhage. The packing is removed in forty-eight hours, and as a rule there is no sign of septic inflammation, the sutured portion of the wound healing by primary union and the cavity granulating up from the bottom. This process can be observed day by day, and it is most gratifying to watch the cavity fill up with healthy granulation tissue with only a serous exudation. Before long the wound has become merely a superficial granulating surface, and as a general rule has healed with a remarkably small scar in less than two months. The granulating cavity is lightly packed with fresh gauze every twenty-four hours.

It has been a matter of great interest to observe how uniformly these cases can be operated upon as described, with free incision through healthy muscles and fascia, in spite of the presence of fairly profuse suppuration, without subsequent general or local evidence of acute infection. It is quite the rule for the sutured portion of the wound to heal by primary union, and for granulation to progress steadily without suppuration. The only precaution observed has been that the cases shall not be operated upon when there is local or general evidence of acute inflammation. Preparatory to operation the wound is rendered as clean as possible, and in this connection I wish to pay tribute to the value of an apparatus with which you are all familiar, namely, Captain Taylor's liquid-tight closure apparatus. For two days preceding the operation this apparatus is applied to the wound, ten per cent. salt solution being employed, and we believe it has been helpful in reducing the number of subsequent inflammatory reactions, in spite of the fact that the sinuses are narrow and tortuous, and sequestra are present in the cavity.

LIQUID-TIGHT CLOSURE.

It must be recorded, however, that occasionally an acute infection of the wound does occur, with redness, swelling and profuse suppuration. It is in these cases, particularly that Taylor's ap-

paratus has proved of the utmost value. No treatment that we have tried, be it fomentation, Carrel-Dakin irrigation, or the application of flavine or dichloramine T has been nearly so effective as the liquid-tight closure treatment with ten per cent. salt solution. As soon as evidence of acute inflammation is apparent the rubber tank is applied with a head of fluid of about one foot and a syphonage from the bed to the floor, and the ebb and flow alternated by two hours positive pressure and fifteen minutes negative. In no case has it been necessary to continue the treatment longer than seventy-two hours, the wound having returned in that time to the condition of quiescence already described, and healing continues as before.

The experience on which these conclusions have been based has covered upwards of five hundred cases of chronic osteomyelitis, under treatment in the Military Orthopædic Hospital in Toronto, and the Granville Canadian Special Hospital at Buxton. The last one hundred cases have been accurately observed and recorded for the purposes of this report. In no case has there been a fatality or any alarming symptom. In all except six cases healing was complete within three months, and in all except fifteen, within two months. The majority were closed in six weeks. In not a single one of these healed cases has the wound broken down, or has further sequestrum formation developed while the cases were under observation. This period of observation has admittedly been short, but the uniformity with which the wounds have healed from the bottom, without the presence of a sinus leading to bone, gives rise to a strong hope that the condition has been permanently cured. The six cases which must be recorded as failures were noted at the time of operation as unlikely to result in cures, owing to the great extent of sequestrum and cavity formation, and the impossibility of performing at one time an operation which could fill all the requirements as outlined. These cases have required or will require further treatment before healing can take place.

Septic Non-Union.

Of even greater interest have been the observations made on the subject of non-union in fractures produced by gunshot wounds and complicated by septic infection. The most striking feature has been the remarkably small number of ununited fractures that have been admitted to these hospitals, to which the majority of such cases

must come. We were formerly taught that septic infection of compound fractures was a potent cause of non-union. The study of this series of compound fractures has led us to think that such a belief is not exactly the truth, and, indeed, that the very reverse is frequently the case. The way in which enormous masses of spongy new bone form around the areas of these fractures and about the ends of septic stumps, cementing together all sorts of irregularities of alignment and even bridging great gaps in the bone, is ample evidence that sepsis is a strong stimulant of osteogenesis and an assistant to union. It therefore seems clear that chronic sepsis by itself is not the cause of delay or absence of healing. Further investigation has shown that in each case some definite factor, other than the sepsis was present. In the majority, it has been the complete destruction of whole segments of the shaft, so that gaps have existed which could not reasonably be expected to become bridged over. In the others the ends of one or both fragments consisted of necrotic bone which either mechanically prevented the junction of the callus growing from the healthy bone beyond, or which, by the constant irritation of its presence, prevented the return of the osteoblasts in the neighborhood to their adult functions of bone-formation, until the area was occupied by fibrous tissue which acted as a mechanical preventive of union.

With our experience of the freedom with which extensive operations can be performed on cases of chronic osteomyelitis, the principles which should govern the treatment of septic non-union are at once apparent. If it is true that mild infection is at a certain stage favourable to osteogenesis, that is the time when every effort should be made to get rid of those factors which are preventing the union. This time appears to be between three and five months after the fracture. It has become our practice, therefore, in all suitable cases to excise the sinus and scar as before described, to chisel the walls of the cavities away, to remove sequestra, to freshen the ends of the fragments, and to fit them together as accurately as possible. Advantage is taken of all irregularities of the bones to secure and maintain close apposition. Usually this is accomplished without any form of internal fixation, but if it is necessary, the fragments are fastened together with a kangaroo tendon suture passed through small drill holes. The wound is closed at the extremities, and a very large opening, directly opposite the fracture,

is left for drainage. For the first week after the operation the limb is immobilized as well as possible in an ordinary splint which allows of the free removal of blood-soaked dressings, and permits the use of the Taylor apparatus, if required, after which a fenestrated plaster bandage is applied.

Such a method of treatment is applicable to all cases in which the ends of the fragments can be brought together without necessitating so much shortening that the function of the limb would be too seriously interfered with. Thus it is particularly applicable to the humerus which can be shortened several inches without interfering greatly with the usefulness of the limb. This is true to a more limited extent in the case of fracture of the femur and fracture of both bones of the forearm and leg. When the failure to unite has been due to destruction of long segments of the shafts, however, or when the non-union resulting from a moderate gap is confined to one of the bones of the forearm or leg, one must be content to direct the treatment solely to the osteomyelitis and to reserve the restoration of the shaft to a bone-graft operation at some later date.

The recognition of these facts changes the whole aspect of the treatment of non-union. Formerly we were content to devote our attention to the simple healing of the wound, postponing the treatment of the fracture for many months, until a clean operation could be safely undertaken. Now we are able to reduce the duration of treatment in some cases by nearly a year, as we are attacking the condition when osteogenesis is at its maximum, and avoiding the period of sclerosis which is so inimical to repair.

Since the introduction of this plan of treatment into these hospitals, twenty-one cases of septic non-union have been operated upon. Of these seventeen were of such a type that when the sequestra and fibrous tissue had been removed, the ends of the fragments could be brought into some sort of contact with each other. In the other four, such large gaps were present that there was no hope of obtaining union without subsequent bone-grafting. Of the seventeen cases we know that eleven have united within ten weeks of the operation; three have united after the lapse of four months; and three have been failures owing to slipping of the fragments or incomplete removal of sequestra.

Septic Mal-Union

One other feature of the treatment of these septic bone cases is deserving of consideration. A good many patients are admitted who have had septic compound fractures which have united in faulty position. Formerly it was our custom to confine our treatment to a cure of the osteomyelitis and to postpone the correction of the deformity until an osteotomy could be performed in a guaranteed aseptic field. This plan had two disadvantages; first, that it delayed the period of treatment for at least a year, and second, that there was always the very grave fear of non-union occurring if osteotomy were performed through the sclerosed region of the fracture. Since our recognition, however, of the principle that mild sepsis is a powerful stimulant to osteogenesis, we have not hesitated to drive a chisel through the ensheathing callus of the fracture and correct the deformity at the same time as we are treating the osteomyelitis. The precaution is taken to see that in the new position of the bones there is actual contact of spongy new bone. This operation has been performed on six occasions, and each time with rapid reunion of the fragments and uncomplicated healing of the wound.

While these latter cases and the ordinary cases of non-union have been difficult to splint efficiently and at the same time allow daily dressings, we have never yet yielded to the temptation to introduce foreign bodies into the wound, such as wires, plates and screws. Many cases have been bequeathed to us by other hospitals in which such operations have been performed. In no case has a successful result been observed, and in all there has been definite injury in the form of persistent suppuration and increase in the area of necrosis.

Conclusions.

In conclusion, it may be of value to recapitulate the principles which have already been outlined.

(1) The periosteum is the medium by which the blood-vessels are distributed to the shafts of the bones. Reflection of the membrane produces superficial necrosis and should never be done when sepsis is present or feared.

(2) The periosteum as reflected in an ordinary surgical operation is merely a fibrous tissue membrane and is not osteogenetic. It should, therefore, never be relied on to restore the shaft after resection.

(3) Mild chronic septic infection is a strong stimulant of inflammatory osteogenesis. It causes widespread osteoporosis, increased vascularity, and abundant callus-formation. This is the state in which cavities are most apt to heal, and fractures to unite, unless prevented by some definite condition such as the presence of sequestra or the existence of too large a gap.

(4) When the irritation subsides or disappears, this rarefying osteotitis gives place to an intense sclerosis which is very inimical to the healing of cavities or the union of fractures.

(5) Treatment should therefore take advantage of the pathological condition which is present at the time the sequestra have separated, and aim at a complete cure before osteosclerosis has supervened. It should consist of the complete excision of the scar and sinus, and the wide removal of the walls of the cavity for the purpose of thorough evacuation of sequestra and unhealthy granulation tissue. All irregularities and pockets must be obliterated, and when possible the depth of the cavity should be reduced by allowing the soft structures to fall into it. Pedunculated muscle or fascia-flaps are of great assistance in promoting rapid healing. Finally, wide-open drainage must be provided so that the cavity can heal from the bottom without depending on the dangerous alternative of a narrow sinus.

(6) Taylor's apparatus is useful in cleansing these wounds before operation and is of great value in the treatment of post-operative sepsis.

(7) Non-union in compound fractures, uncomplicated by great loss of bone, is rare. When present, the fact that the wound is septic is no contra-indication to active treatment of the fracture, as well as of the osteomyelitis. Gratifying results may be anticipated from thorough freshening of the ends and adjusting of the fragments, providing efficient drainage is secured.

(8) The best time to correct mal-union in septic cases is at the time of the operation for the cure of the disease in the bone.

OSTEOCHONDRITIS OF THE HIP

PERCY WILLARD ROBERTS, M. D., NEW YORK.

In November, 1917, the writer reported two cases of osteochondritis of the hip, variously known as Perthes' Disease, Legg's Disease and "quiet hip disease," in which there was direct evidence of inherited syphilis and rapid relief of symptoms following the administration of mercury and potassium iodide. Since then eight more cases have been added to the series, making ten in all. The indications presented by these that osteochondritis of the hip may be of syphilitic origin prompts this additional report in the hope that it may stimulate others to further investigation of the probable luetic etiology of this condition, and particularly to observation of the effect of vigorous antisyphilitic treatment.

As previously pointed out, the pathologic findings reported by Perthes coincide with one of the most common expressions of bone syphilis encountered in young children, namely, osteochondritis. Lesions of this nature occurring in the region of the knees, wrists and ankles were described many years ago by Parrot and others, and are referred to in every text book which treats of the much neglected subject of bone and joint conditions due to inherited syphilis. The course of osteochondritis of the hip is similar to that of the same process elsewhere in its tendency to spontaneous recovery with good function, and the usual lack of acute symptoms, which led to H. L. Taylor's designation of "quiet hip disease," forms another link of resemblance to osteochondritis of the wrists, knees and ankles.

Again, we often find in subjects with osteochondritis of the hip dental evidence of inherited syphilis. Not, necessarily, the hutchinsonian teeth, but various forms of hypoplasia of the enamel which Cavallaro so convincingly argues are due to fœtal infection by the treponema pallidum.

The contention that the frequency of negative Wasserman reactions in these cases percludes the probability of their syphilitic origin is not well founded. Serologists of experience agree that the blood of syphilitic children often fails to give a positive reaction with alcoholic antigens and that even with the use of cholesterin negative results occur not infrequently. In the writer's experience this has been confirmed many times in cases where the

family history was positive and where existing lesions cleared up under mixed treatment. Of the eight bloods examined in the series reported below one gave a four plus reaction, one a three plus, two gave a two plus, three a one plus and one was negative. A positive family history was obtained twice.

The impressive feature of these cases was the rapid recession of existing symptoms and the prompt increase in hip motion following the administration of mercury and potassium iodide.

Case Reports.

Case 1. Girl aged 8. In July, 1914, had pain in right hip and limped. Treated at two orthopedic clinics for tuberculosis of hip, wearing plaster spica. Wasserman December 4, 1915, negative. Came under observation March 21, 1917, wearing spica. Hip extremely sensitive, very little motion. Radiograph showed typical osteochondritis. Spica again applied; prescribed Hydrarg. Chlor. Corr. Gr. 1-64, K. I. Grs. iii three times a day. One week later plaster was removed and hip was less sensitive and more freely movable. Improvement continued and in ten weeks thigh could be flexed to a right angle. Child was very active, very little limp. Wasserman January 29, 1918, four plus. Father confessed to syphilis before marriage and a Wasserman taken April 10, 1918, was four plus.

Case 2. Girl aged 11. Had had hip symptoms for a year and three months when she came under observation, May 2, 1917, limped in walking, favoring right hip. Flexion of the thigh could be carried to ninety degrees before eliciting spasm; no abduction, no rotation. The teeth showed evidence of congenital syphilis and child was placed on mixed treatment. In two weeks there was less spasm and greater range of hip motion. In four weeks hip could be flexed to forty-five degrees less than a right angle, spasm had almost disappeared, child was very active. In ten weeks there was practically normal flexion and rotation, no limp. X-ray showed typical osteochondritis of right hip. Wasserman one plus.

Case 3. Boy aged 10. Treated two years for Perthes' disease wearing spica most of the time. Symptoms more acute than is usual in this condition. Radiograph typical of osteochondritis. April 29, 1918, extension of hip was limited to 165 degrees, flexion to 130 degrees. Any attempt to carry the thigh beyond these limits brought tears to the boy's eyes. Rotation of thigh blocked; no

abduction nor adduction. Short spica reapplied, mixed treatment ordered. Three weeks later thigh could be fully extended and flexed to a right angle without pain. There was about twenty degrees abduction, free rotation in extension, some with thigh flexed. Spica omitted. After ten weeks of mixed treatment thigh could be flexed to within ten degrees of normal, patient walked without limp and had fairly free rotation and abduction. No Wasserman was made. Father had syphilis before marriage.

CASE 4. Boy aged 9. Symptoms for one year. First treated for rheumatism then for tuberculous hip. Wore plaster spica six months. Hip stiff, marked limp. Placed on mixed treatment. In five weeks the patient was playing ball and was very active in all boys' games. Hip motions somewhat increased. Recovery proceeded without interruption. The blood in this case was negative.

CASE 5. Girl aged 5. Bilateral disease with both epiphyses nearly obliterated. Wasserman two plus. In this case one-half grain doses of hydrargyrum cum creta were given with ten grains of potassium iodide three times a day without satisfactory results. When one-sixth grain doses of mercury protiodide twice a day were substituted improvement was rapid and continued until nearly normal function was regained in three months.

CASE 6. Girl aged 6½. Osteochondritis of right hip. Dental evidence of syphilis; Wasserman one plus; typical X-ray; no special features; normal function in four and a half months.

CASE 7. Girl aged 5. Osteochondritis left hip; typical X-ray; Wasserman one plus; child did not return for treatment.

CASE 8. Girl aged 8. Symptoms for one year. Treated first for tuberculosis of hip, later for Perthes' disease. Wore plaster spica or braces until four weeks before coming under observation April 23, 1918. Child then walked with marked lurching limp. Flexion of thigh checked by sharp spasm at a right angle. Rotation in flexion and also abduction of thigh considerably limited. Radiograph typical of osteochondritis. Dental evidence of inherited syphilis. Wasserman not taken. Family history negative except that grandfather died of "something like tuberculosis" and one uncle had some form of mental disease. Prescribed protiodide of mercury grain 1-6 three times a day. Two weeks later limp was less marked, flexion of thigh had increased thirty degrees, rotation improved, abduction still limited. Five weeks after beginning of

treatment limp was scarcely noticeable, child extremely active, flexion, rotation and abduction of thigh nearly normal, no muscular spasm.

CASE 9. Girl aged 8. Hip symptoms of mild degree appeared in 1914 and continued more than three years, with complete functional recovery except very slight limp. Radiographs typical of osteochondritis of hip. No active treatment was advised except one plaster spica worn for a few weeks in 1914 and another worn for twelve weeks in 1915. A Wasserman taken early in the disease was negative, another taken a few months later was plus-minus and a third taken in 1918 was one plus. There was dental evidence of inherited syphilis in the deciduous teeth.

CASE 10. Boy aged 8. Symptoms which had existed for three months were so acute and limp so marked that first diagnosis was tuberculous hip. Plaster spica was ordered but its application was deferred to note the effect of medication. Potassium iodide up to twenty grains three times a day prescribed. In two weeks there was less pain and more freedom of motion. Four weeks later there was no pain, no spasm, very little limp. Hydrar, Chlor, Corr. Gr. 1-64 three times a day was added to the K. I. Three months after beginning of treatment the hip was apparently normal. Radiograph showed typical osteochondritis. Wasserman three plus.

Editorial

In order to reduce their disability to a minimum and to insure, as far as possible, their future independence, the government has wisely provided for our war cripples such a group of hospitals and such a scheme of hospital care and special training as has never before been seen or even dreamed of in this country. This situation in the military hospitals while most satisfactory, yet gives us food for serious thought in several ways.

We have, perhaps, twenty-five thousand war cripples. For the care of these, there is employed by the government, at the present time, approximately one medical officer for each fifty cases; one nurse for each twenty-five cases; one sergeant, corporal, or private in the medical corps for each twenty cases; one reconstruction aide for each fifty cases; and one instructor in the vocational schools for perhaps each fifty cases. This makes seven or eight individuals employed for the special care of each fifty of the war cripples. This does not include the officers and others engaged in the executive and administrative departments.

Now turn from this picture to another. We conclude that there is approximately one war cripple for each four thousand of our population, but we also know that we have in the United States in the neighborhood of three hundred and fifty thousand crippled children, one to each two hundred fifty or three hundred fifty of the population.

The experience of a number of institutions has shown that from sixty to eighty per cent of these children may be cured or greatly improved by proper hospital care, in other words, by modern orthopaedic surgical methods.

There is as yet no government interest in these cripples. A few states have provided special hospitals. A number of special hospitals have been provided by private philanthropists. There are, however, only a few thousand beds in all special hospitals of this kind in the United States.

These children patients are not only highly amenable to improvement by special surgery, but they can be greatly helped on

the way to independence by special training methods and special opportunities for education. Generally, their hospital care and special training should, as with the soldiers, go hand in hand. No one questions that the program of hospital care and special training for the soldiers wounded in the war was excellently conceived and splendidly executed. It is certainly a fact, however, that the neglect of civilian cripples is as unfortunate a thing as it has been to expose our boys to the crippling effects of the war. In the same way, relief for the crippled children is as imperative a duty as the effort to remedy war damage to the others.

British Orthopaedic Association

A special meeting of the British Orthopaedic Association was held at Liverpool on May 30th and 31st, 1919.

On May 30th the morning was devoted to a discussion upon "The Treatment of Flail Joints of the Upper Limb Following Gunshot Wounds," opened by Mr. Naughton Dunn (Birmingham) and Mr. Harry Platt (Manchester). This extremely difficult problem in war orthopaedics, produced a very active and interesting discussion. Professor Wood Jones explained the anatomy of two cases of snapping hip as demonstrated by operation and compared with the parts as found in normal dissections. Professor Wood Jones found that the snap was due to the existence of a strong deep tendon in the gluteus maximus, inserted low down, the patient being able to make this tendon snap across the great trochanter when the gluteus maximus was contracted. The snap was demonstrated on the operating table by faradising the glueteus maximus muscle. Mr. Rocyn Jones (London) showed skiagraphs of a case in which after reduction of a congenital dislocation of one hip, tuberculous disease developed in the other hip whilst the patient was fixed in plaster.

In the afternoon the following papers were read: "Two cases of unusual accidents to amputation stumps," by Mr. Muirhead Little (London).

"Some speculations on the functions of scar tissue," by Mr. D. McCrae Aitken (London).

"Observations on the treatment of static disabilities of the feet," by Mr. W. H. Trethowan (London).

"On the operative treatment of paralytic talipes calcaneo-cavovalgus," by Mr. Naughton Dunn (Birmingham).

In the evening the Association dined together at the Adelphi Hotel.

Saturday morning was spent at the Special Military Surgical Hospital, Alder Hey, where an interesting series of cases was shown by Major Armour and Capt. McMurray, and other members of the staff. The hospital wards, special treatment departments and workshops were open to visitors.

In the afternoon a visit was paid to the Liverpool Country Hospital for children at Heswell, which is beautifully situated overlooking the mouth of the Dee. Here after the open air wards had been inspected two operations were performed by Sir Robert Jones, transplantation of the peroneus longus and correction of a relapsed club foot, and one, reduction of congenital dislocation by Mr. Laming Evans. The Association then visited the children's country hospital at Leasowe, another open air institution overlooking the sea. This hospital is for 200 tuberculous children and is supported by the Corporation of the City of Liverpool.

Over fifty members and visitors attended the meeting.

Current Orthopaedic Literature

WAR CONTRACTURES—LOCALIZED TETANUS, REFLEX DISORDER, OR HYSTERIA. By Lieut.-Col. Arthur F. Hurst, R. A. M. C. Seale Hayne Military Hospital.

The author's article covers 26 pages, has 32 excellent photos and 5 diagrams. He disagrees with Babinski and Froment in the second edition of their book published in 1917.

In the early stages the diagnosis between localized tetanus and hysterical spasm may be extremely difficult. If the contractures persist without abating for more than 3 or 4 weeks, and do not disappear completely at the end of 6 or 8 weeks, they are probably hysterical, even if they were at first due to tetanus. Spasms which begin immediately after the wound is inflicted cannot be due to tetanus; they are generally reflex and protective in nature, but are often maintained after the first few hours or days by auto-suggestion. A later onset is compatible with both tetanus and hysteria, and in both the extent of the contractures is often out of all proportion to the size of the wound. If the contracture persists in sleep, hysteria can be excluded. A general anaesthetic causes hysterical contractures to disappear more rapidly than tetanic contractures, which persist to some extent even under deep anaesthesia, although even the former may still be present after consciousness is lost. If the muscles are of a wooden and unvarying hardness, tetanus is almost certainly present. An increase in the size of the muscle, possibly due to obstruction of its lymphatics, without tenderness or subcutaneous oedema, is conclusive evidence in favor of local tetanus. The continued tonic contraction in tetanus is generally accompanied by spasmodic and more or less painful contractions, which are often brought on by external stimuli.

Froment and Babinski believe that many of the contractures which have hitherto been regarded as hysterical, or due to some obscure condition such as an ascending neuritis, as believed by Tinel, are really reflex in origin. They have summarized their views in the second section of their book published in 1917 on Hysterie-Pithiatisme et Troubles Nerveux d'Ordre Reflexe en Neurologie de Guerre. This theory at first seems to offer a satisfactory explanation of many cases, the nature of which had hitherto remained obscure; but a critical investigation of the subject has convinced us that such reflex conditions never occur.

There is no doubt that reflex contraction of the neighboring muscles is not uncommon immediately after a wound is inflicted, the reflex being protective in nature. When the symptom persists after the wound is healed, it is no longer due to any reflex action, but is the result of suggestion; the contracture is thus primarily reflex and subsequently hysterical.

If a hysterical condition is not diagnosed, they will receive long series of treatment for localized tetanus or reflex symptoms and will lose the value of psychotherapy.

The posture in hysterical contractures is identical with that which happened to exist at the time the contractures developed, and is in many cases that which was assumed immediately after the injury. Thus, if one or more peri-

pheral nerves were damaged, the position corresponds with what would result from paralysis, or occasionally from irritation, of these nerves. In such cases, when the nerve recovers from the effect of the injury, which may be within a few hours if the latter is nothing more than slight concussion, or may be weeks or months if it is more serious, the abnormal posture and the inability to move are maintained as a result of suggestion. In other cases the injury may lead to reflex spasm of the neighboring muscles and inhibition of movement of the whole limb which is protective in nature, but which rapidly disappears as the condition of the wound improves. The patient more or less subconsciously assumes the position which gives most relief to the pain. He does not realize that the absence of voluntary effort on his part had the object of saving him from pain, but believes that it was due to "paralysis"—the direct result of his injury.

Histories are presented illustrating all points raised by the author. Also the several positions of the joints assumed in hysteria.

In many cases the posture is that in which the surgeon fixed the limb by means of splints or bandages when it was first dressed. The patient becomes so accustomed to the immobility of the joint, that when the splint or bandage is removed, he fails to realize that there is nothing to prevent the return of the normal functional activity. He makes a feeble effort to bend the joint, finds that it gives rise to pain without any obvious movement resulting, and gives up the attempt in despair, reconciling himself to the notion that the joint has become fixed as a result of the operation and that no voluntary effort that he can make will have any effect upon it. A little manipulation, accompanied by a few words of explanation, could at this stage dispel the idea in five minutes, and months of disability would be saved.

The development of hysterical contracture and associated paralysis is due to the fact that the patient fails to realize that there is no reason why the spasm should not relax and the power of movement return when the primary factor—nerve injury, protective reflex, a conscious or subconscious antalgic spasm and inhibition of movement, localized tetanus, or fixation by splints or bandages—is no longer operative. The patient regards the contracture and inability to move as direct results of his injury, and naturally ignores the intermediate cause, such as the pain or tetanus. If it had been pointed out to him, when the pain was disappearing, that his incapacity was due to the pain and only indirectly to the injury, and that there was therefore no longer any reason why it should be maintained, he would have made the necessary effort and the hysterical condition would never have developed. Hysterical contractures and paralysis may result from injuries to the soft parts of the limb, with or without the bones and joints being involved. We have observed contractures and paralysis of exactly the same nature in the absence of actual wounds—as, for example, in fractures, dislocations, sprains and contusions.

The normal circulation thru a limb depends upon its active movements, the afferent nerve fibres from the muscles probably giving rise to localized reflex vaso-dilatation. If for any reason the arm is not moved in cold weather, the hand becomes shriveled, white or blue, numb, painful and stiff. These well-recognized changes disappear at once with active exercise and on warming the limb, both of which restore the circulation. The tendency to disturbances of this kind is much greater in people with a poor circulation than in those with a nat-

urally good circulation. It is thus natural for the immobility caused by paralysis or contracture of a limb, whether organic or hysterical, to result in deficient circulation and the same secondary changes.

When the venous and lymphatic stasis is very marked, and the paralysis absolutely complete, oedema may occur, especially if the paralysis is accompanied by contracture in a position in which the veins and lymphatics are obstructed by the rigid muscles. The deficient circulation results in changes in the physiological properties of the paralyzed muscles, even if the paralysis is entirely hysterical. When the hysterical contractions are cured circulation improves, and the parts gradually return to the normal. In breaking up hysterical joints one often tears the normal joint soft parts rather than adhesions and the resulting effusion is due to the tearing of the soft parts. Hysterical contractures only disappear after deep anaesthesia. Violent movements with incomplete anaesthesia may thus result in tearing contracted but otherwise normal muscle fibres as well as of normal fibrous tissue.

Anaesthesia due to cold if oft repeated may become hysterical in nature by auto-suggestion. This anaesthesia may be so complete that trophic ulcers may follow.

In hysterical contractures the x-rays show abnormal transparency of the bones, which is apparently due partly to deficient calcification and partly to absorption of the bony tissue, but we have never observed and definite alteration in their outline. Although the joints occasionally appear to be enlarged, the x-rays show no change in the articular surface: this corresponds with the fact that hysterical disorders of joints never give rise to any anatomical change as the result of pressure exerted on abnormal surfaces, however long the condition may persist. The enlargement of the joint may be due partly to oedema from deficient circulation, but is more often simply apparent, and due to the atrophy of the soft parts round the shafts of the bones. Lastly the nails become thin, brittle abnormally opaque and often show longitudinal grooves.

The excessive sweating which often occurs in these cases is less easy to explain. It may in part be a direct result of the cutaneous asphyxia when the circulation is unusually feeble. In cases of contracture in which the hand is tightly flexed, it is in part due to the air in contact with the palm being kept warmer than that in contact with the palm of the normal hand, and to the diminished evaporation which occurs in the enclosed space formed by the clenched hand. It is possible that the intense nerve impulses sent down from the brain to the centres in the spinal cord spread from the motor nerve-cells to the neighboring sympathetic nerve-cells which control the secretion of sweat. This would explain the fact that the sweating may occur, through to a less extent, in the normal hand.

When hysterical paralysis, with or without contracture, has persisted for some months and the psychotherapy leads to rapid recovery, it is often observed that, although the patient is able to perform every movement in a perfectly normal way at the end perhaps of an hour, he tends to maintain the abnormal posture, which was caused by the paralysis and contracture, directly his attention is withdrawn from the affected limb. Only if he constantly thinks of keeping his limb in the normal position, does the latter gradually become adopted even when no attention is given to it. Another striking fact about

these conditions is the maintenance of the abnormal posture of the arm or leg during sleep. Hysterical contractures disappear during sleep, but in spite of this the abnormal posture is maintained, so that it is only by actually manipulating the limb that the absence of the spasm of the affected muscles can be demonstrated.

The diagnosis of an hysterical contracture depends primarily upon the incompatibility of the symptoms with the injury. An injury to a nerve cannot account for persistent spasm of the muscles it supplies, and still less for that of other muscles; persistent muscular spasm resulting from injuries is thus invariably hysterical, unless the pyramidal tracts in the brain or spinal cord have been directly damaged.

If the posture is due to the perpetuation by suggestion of a position, which developed under the circumstances which uncontrollably placed the limb into a position the patient could not voluntarily assume, its maintenance for a more or less prolonged period before the responsible circumstances cease to be operative would be sufficient to train the muscles involved to continue to act in the same way, and would also lead to the development of postural length of the muscles, which would help to keep the part in the abnormal position, even after psychotherapy had resulted in a cure of the contracture and paralysis.

Treatment begins with a full explanation of the cause of the symptoms in language suited to the patient's intelligence and degree of education, followed by persuasion and re-education, combined in most cases with manipulation, which doubtless acts to some extent by suggestion. A very important, but by no means essential, preliminary is the creation of a proper atmosphere of cure. The patient is made to understand that any treatment he has already received has prepared the way, so that nothing now remains but a properly directed effort on his part, with our help, for complete recovery to take place. During the whole course of treatment he is engaged in conversation, and the meaning of each successive step is carefully explained. He is made to watch the contraction of the muscles and play of the tendons of the normal limb, and to attempt to imitate them in the affected one. In some cases it is not even necessary to touch the patient, mere explanation and persuasion being sufficient to cause him to relax any spasm which may be present, and then to perform the various movements of the part with quickly increasing strength and rapidity.

When very great difficulty is experienced in getting the contracted muscles to relax, the limb should be placed in very hot water, and the manipulations carried out when the circulation has been artificially improved in this way. Some relaxation always occurs because the rigidity is in part the direct result of the deficient blood supply. Passive movements are most effective if carried out by the medical officer himself, as the patient is engaged in conversation the whole time and made to take an active part in the movements from a very early stage in the first sitting. For this reason we never employ the mechanical appliances for performing passive movements, which have been boomed to such an extent during the last few years.

The paper is an excellent summary on hysteria.—*Leo. C. Donnelly, Detroit.*

TREATMENT OF PURULENT ARTHRITIS BY WIDE ARTHROTOMY FOLLOWED BY IMMEDIATE ACTIVE MOBILIZATION. By Dr. C. Willems, Ghent, Belgium.

No therapeutic law has been more firmly established than that which has made immobilization obligatory for every joint injury, from the mild to the most severe. Nevertheless we all know its consequences; muscular atrophy which is rapid for certain muscles such as the femoral quadriceps, and stiff ness of the joint. Also we know that such complications when once established are extremely tenacious and that frequently they do not yield completely to varied and very prolonged physiotherapeutic treatment. Even in the more fortunate cases it is necessary to continue such treatment for some months before getting the required results. Immobilization has been considered a necessary evil.

I have freed myself by degrees from practicing the law of immobilization. I commenced evacuatory punctures to drain traumatic effusions of the knee, hemarthroses and hydarthroses, and by making the patient walk immediately. Not only could they do this without any difficulty but their lesions cured in a few days without leaving any trace.

Since the war the great frequency and infinite variety of articular lesions gave me the opportunity of applying this new method on a large scale. In the simplest and most severe conditions I have used immediate active mobilization after the operations for penetrating joint wounds with or without an included projectile and for all varieties of intra-articular war fractures. I have not confined myself to non-infected fresh cases. I have also treated cases of purulent arthritis and it is perhaps in these difficult infected cases that the method has given the most astonishing success. But the object pursued differs. In simple lesions immediate active mobilization obviates atrophy and ankylosis. In purulent arthritis it seeks on the contrary to drain the articulations. In the first case the joint must be completely closed; in the second it must be left widely open.

A word as to the technique. It is practically the same whether the wound is aseptic or infected. In the case of recent injuries we commence by excising the soft parts of the wound, proceeding with the eventual esquillectomy of the fracture area, extracting projectiles and hermetically closing the joint. In purulent arthritis on the contrary; we must first execute an arthrotomy and leave the wound largely open. But starting from this movement we always proceed in the same way for mobilization.

The expression "immediate active mobilization" must be taken in its literal sense. The mobilization must be active, that is to say, made by the patient himself by muscular contractions. The movements ought to reproduce the essential normal movements. Extension, flexion and rotation. The goal to be reached is to restore the physiological function of the articulation as much as possible, and in the case of the knee this function is walking.

Active mobilization cannot in any way be replaced by a passive mobilization which does not call into play either the muscles of the limb or its nutrition and which tends to restore mobility alone.

Mobilization must be immediate, that is, commenced as soon as the patient awakens from the anaesthesia. The patient must not be permitted to rest. The

movement must be pushed to the maximum in every direction and must be kept up, so to speak uninterruptedly. He needs supervision by a personnel in touch with the necessities of the treatment.

Active mobilization is not painful in the true sense of the term, except according to the extent of the lesions, the courage of the patient and his aptitude in directing his efforts to the muscles which must be contracted and not wasting his strength in contracting other muscles than those necessary, movements become easy according as they are repeated.

Active mobilization is not painful in the true sense of the term, except when it displaces large bone fragments and in such a case it is contra-indicated. But the movements are laborious and call for effort. It is found that a patient treated by active mobilization uses his limb in a variety of non-prescribed ways which he would not employ if the movements were painful. Many have stated that when a little pain is felt in periods of rest the best way of stopping it is to resume the movements.

Active mobilization gives the most surprising results in purulent arthritis. I do not hesitate to assert that against this formidable infection the new method is more efficacious than any of the means hitherto at our disposal.

In applying mobilization to the treatment of articular suppurations, my chief aim was to realize a satisfactory drainage after arthrotomy. We know that efficacious drainage of a joint by the ordinary means is a Utopia. No kind of tube, no system of tampons, no means of irrigation, obviates retention nor stops the progress of infection. And it is on account of this insufficiency of drainage that arthrotomy has been almost abandoned and replaced by resection. But I have always been under the impression that to resect for the purpose of drainage alone is to go too far; and I have endeavored to empty the joint by expression, thanks to active movements. When a suppurated articulation has been opened by a large uni- or bilateral arthrotomy (a uarthrotomy is never necessary) this is what is observed: At each extension and at each flexion the synovial surfaces are forced together by muscular contraction and pus is expressed often in the form of a jet. When the movements are very extensive and the muscles contract more vigorously the expression of pus is so much the more complete. If the movements are repeated a sufficient number of times the secretions are eliminated in accordance with the movements, retention is prevented and articular drainage profoundly influences the local and general conditions. Locally, suppuration evolves like an ordinary abcess, but slowly. It lasts for a few weeks abundant at first, then less and finally disappears completely. During this period, the arthrotomy opening or openings cicatrize. A species of fistula persists which closes from time to time and must be periodically opened. Oedema of the periarticular tissues diminishes very rapidly and the tissues remain supple. Peri-articular abcesses are, so to speak, unknown.

With regard to the general state it is rapidly modified. From the commencement of active mobilization fever falls, not completely, as the patient may show 38 degrees C. for some time. But the feverish aspect disappears; such patients do not look like badly infected cases.

Drainage is therefore realized in an ideal manner without a tube, and without irrigation of any kind. I am of the opinion that irrigations are more harmful than useful.

Drainage was my aim at first but I obtained more. I have obtained preservation of the articular mobility. Unquestionably we must consider the recovery of a purulent arthritis with ankylosis as satisfactory, and be thankful that the patient has escaped resection, but it is evident that a mobile joint is much better than the best kind of ankylosis.

If the procedure is followed in the manner indicated, mobility of the joint will always be preserved. From the moment suppuration notably diminishes we sometimes see a tendency to stiffness. This is why I now partially and progressively close the arthrotomy wounds from this moment, and only leave such openings that are strictly necessary for the discharge of pus which is still forming. Proceeding in this way, mobility will be perfect and absolutely normal in the great majority of cases, no matter what the causative microbe may be. The limb will show no functional disturbance after an infection as terrible as purulent arthritis was formerly considered.

In purulent arthritis still more than in non-infected lesions it is difficult to realize the possibilities of active mobilization. It is so contrary to classical ideas that we must see the patients move their limbs in order to understand. The truth is that movements are perfectly possible in purulent arthritis treated by arthrotomy, to the same extent as in non-infected articular lesions treated by incision of the damaged tissues and total primary suture. Movements are no more painful in the first place than in the second. They are equally laborious in the two cases. True pain appears only when the drainage is insufficient; and when it becomes necessary to drain more completely to cause an immediate cessation of pain. Whenever a patient complains of pain, especially in the politeal space, it is almost certain that there is retention. The patients themselves soon learn to recognize this cause of pain and stop it by means of some movements.

Patients with purulent arthritis of the knee can walk early, even before cicatrization of the arthrotomy wound. It is the same with purulent tibiotarsal arthritis. It is a curious experience to see them walk with the joint widely open, expelling a little pus at each step.

With regard to the question whether immediate active mobilization is applicable to cases in which purulent arthritis accompanies an intra-articular fracture, it can be answered affirmatively. As in non-infected lesions mobilization can be effected in purulent arthritis with fracture on condition that there is no fear of displacing the fragments. If there is, movements are contra indicated because they might dislocate the joint.

A second circumstance which renders this method inapplicable is primary destruction of the ligaments and of the articular capsule. When the means of union have disappeared it is evident that the joint can no longer be mobilized by muscular contraction. But it is well to know that a partial destruction of the means of union does not render the treatment quite inapplicable.—*Leo. C. Donnelly, Detroit.*

THE "NO SPLINT" TREATMENT OF FRACTURES ABOUT THE SHOULDERS, IN THE HUMERUS AND THE ELBOW. Dowden, J. W. *Edinb. M. J.* 1918 XXI, 328.

Dowden claims that as a result of his "no splint" treatment of fractures about the shoulder, in the humerus and the elbow, it is possible for a patient to return to work in six or eight weeks, regardless of the nature of his occupation.

His treatment of fractures is mainly without splints, unless application is found absolutely necessary. For ten years he has been treating fractures in these regions without splints and has never been disappointed, nor has he ever had a case of non-union or a single bad result.

The patient is encouraged to use his fingers and do what he can with them, carefully to pronate and supinate, flex and extend the forearm, and gently try to move his shoulder-joint and arm, but never to the extent of producing pain.

He has endeavored to apply the same principles to the leg as to the upper extremity, but as yet has not been able to perfect a method.—*Leo C. Donnelly, Detroit.*

THE TREATMENT OF THIGH FRACTURES WITH A MODIFIED THOMAS SPLINT. Hardouin: (Note sur le traitment des fractures de cuisse par l'appareil de Thomas modifié) Bull. et mim. Soc. de chir. de Par., 1918.

Fixed in the ordinary way as for transportation the author got bad results with the Thomas splint, the patient complaining of ischiatic pressure, and the apparatus slipping above the ischium in any movement of the patient, which annulled the action of the apparatus. To prevent this, the author placed a plaster jacket around the pelvis and the upper part of the thigh over the seat of fracture. When the plaster was dry, contra-extension was applied and the Thomas splint then applied in the usual way, being fixed high and solidly on the plaster cast by strong bandages or other means.—*Leo C. Donnelly, Detroit.*

GUNSHOT WOUNDS OF THE SPONGY BONE TISSUE. De Gaulejac, H., and Nathan, M. (Les lésions de l'os spongieux par projectiles de guerre.) Rev. de chir., 1918, IV, 341.

The author calls attention to the gravity of these lesions and states that they are frequently overlooked.

These damages can only be observed after wide excision and the turning back of the periosteum. This is necessary in the treatment of all penetrating projectile wounds. Examination shows that a projectile causes disruption of the osseous tissues as in the soft parts. The fragile structure of the spongy tissue explains the extent and gravity of these lesions, which soon give rise to haematomata. These injuries are contusions in the same sense as those of the soft parts. They differ only in the primarily massive character of the necrobiotic lesions which form favorable culture media for microbes.

In this type of lesion, important both because of its extent and primary septicity, there is very often a long period of latency.

The prognosis is grave. Apart from local manifestations, of which arthritis is the commonest, there are general complications which may become chronic. As regards surgical treatment, experience has shown that periosteal decortication and wide excision of tissues is the only way to ensure healthy primary reunion.—*Leo C. Donnelly, Detroit.*

KOBLER'S DISEASE OF THE TARSAL SCAPHOID IN CHILDREN. Frederick W. O'Brien. *Boston Medical and Surgical Journal*, April 17, 1919.

The cases in the literature are taken up, and one is reported with X-ray examination.

The various suggested causes are taken up, viz: traumatic osteitis, fracture of the ossification center. The X-ray findings are typical. The scaphoid is smaller, form regular, architecture impossible to recognize, and density increased. The trouble disappears under indifferent treatment.—*Edward S. Hatch, M. D., New Orleans, La.*

TREATMENT OF CASES OF FRACTURED FEMUR AT A BASE HOSPITAL IN FRANCE. *British Journal of Surgery*, January, 1919. Lieut. Colonel Victor Hurley and Maj. S. H. Weedon.

The author's report on the methods and conclusions drawn from 170 cases of fracture of the femur treated in a Base Hospital during a six month period from July to December, 1917. All cases were treated until firm union had occurred and various methods were used. The Thomas knee splints were used with such modifications as were deemed necessary.

Patients arrived in the hospital within 36 hours to 7 days from time of injury; most of the cases being admitted on the third and fourth days, having had preliminary treatment at the casualty clearing stations, where they usually received the Thomas splint. The wounds had been excised with a varying degree of thoroughness. The authors believe that ordinary soap and water or saline give as good result in the after care of the wounds as the antiseptic lotions and pastes. The cases which did the best were those in which the wounds were thoroughly excised and adequate drainage had been provided. There was a mortality of 38 per cent within 48 hours after admission. Portable X-ray apparatus was used which allowed the patient to remain undisturbed and which is essential to obtain the best results. The indications for general anaesthesia are given.

Since in war surgery, patients are passed on from surgeon to surgeon the indications for further operation are given as (1) spreading sepsis or gas infection in incompletely drained wounds; (2) insufficient removal of bone fragments; (3) Vascular gangrene of the limb.

The splint selected must be determined by; (1) the position and extent of the wounds in the soft parts; (2) the site of fracture. The Thomas knee-splint was found most serviceable except in those cases with extensive wounds of the

buttocks and posterior aspect of the thighs, in which a Hodgen splint was used. In some cases where the wounds of the buttocks and pelvis were so extensive that no splinting was possible, a Sinclair net bed or Bryan's bed was used. In fractures of the head, neck, or upper third of the femur a double Thomas knee splint was used. In those below this level a single Thomas splint was used. Extension is obtained by the use of a bandage or Sinclair's glue or a caliper extension device by Major M. Sinclair. The authors describe their method of application of splints and have splendidly illustrated the article. Regular massage is carried out and the motion of the hip joint is encouraged as soon as firm union has been established. From the commencement the patient is instructed to perform each day a certain number of movements of his feet and toes which is readily permitted on a foot piece which is used.

Sepsis, secondary hæmorrhage, arthritis, associated nerve injuries and foreign bodies are taken up.

The length of time necessary to obtain firm union is determined; (1) by the extent of the original loss of bone; (2) the degree of subsequent sepsis; (3) accurate reduction of deformity and (4) complete division of the sciatic nerve.

The proportion of cases in which non-union occurs was probably not greater than 1 per cent.—*H. W. Meyerding, M. D., Rochester, Minn.*

EARLY TREATMENT OF COMPOUND FRACTURES AND OTHER SEVERE INJURIES OF UPPER LIMB.—F. G. Slessinger, *Lancet*, March 8, 1919.

PRIMARY SUTURE—INJURIES WITHOUT FRACTURE

The whole injured tract is excised en bloc, try to restore the functional anatomy of the limb, and suture nerves in all possible cases, this helps even though the wound is septic. Both severed vein and artery should be tied. Heat for the parts is useful in primary suturing.

WOUNDS COMPLICATED WITH FRACTURES.

Completely loose bone fragments should be removed, fractures of the lower end of the shaft of the humerous are often best put up in extreme flexion. If there is any paralysis of the musculo spiral group of muscles the nerve should be repaired at once. The middle third of the radius is hard to hold in position, as are of course fractures of both bones of the forearm. Extreme supination should be kept up. A tennis ball placed in the palm helps.

In joint wounds a thorough, immediate cleansing and closure give the best results.

When the head of the humerous or radius is badly shattered incision is best done at once.

In infected wounds removal of dead tissue and the use of Dakin Solution for its hydrolytic action is advocated.

EDWARD S. HATCH, M. D., *New Orleans, La.*

DISEASES OF THE BONES, JOINTS, MUSCLES, TENDONS, CONDITIONS COMMONLY FOUND IN THE EXTREMITIES. De Gaulejac and Nathan. Pathologic Study of Bone Substance. (Etude pathologique des pertes de substance osseuse) Bull. et mem. Soc. de chir. de par., 1918, xliv, 1918. Vol XXVIII, June, 1919. No. 6. *Sur. Gyn. and Obst.*

The conclusions reached by the authors are as follows:

1. Periosteum owes its osteogenetic properties only to the bone particles which adhere to its deep face. This faculty is common to it and other kinds of connective tissue.

2. Ossification takes place in the interior of a Haversian canal the lumen of which is progressively diminished and obstructed.

3. Ossification may take place also by diffuse proliferation of the osteoblasts which progressively invade the neighboring connective tissues.

4. Ossification may be effected directly without the mediation of osteoblasts by the simple transformation of collagen into pre-osseous substance. In such case, as Nageotte has observed, the fibroblast takes on the character of an osteoblast only after complete transformation of the collagen.

The clinical deductions from this part of the study are:

1. The presence of a haematoma is an obstacle to bone regeneration.

2. The larger the surface of bone in contact with the neighboring connective tissues the better.

3. Bone repair may be effected at the expense of fibrous tissue, the collagen of which is transformed into pre-osseous tissue under the influence of its surroundings.

In regard to the reaction of the compact bone, the authors reach the following conclusions:

1. Compact bone has one fertile bed, i. e., the middle bed, that of the Haversian canals. This osseous bed reacts to all traumatic or inflammatory causes by a more or less complete return to the condition of indifference.

2. The reaction, which can be seen radiographically, shows enlargement and multiplication of the Haversian canals and diminution of the standing affinity of the bone substance.

3. When the external limiting layer of bone surface is destroyed, the middle bed, if uninjured or injured only slightly, is capable of proliferating into the neighboring connective tissue. Hyperostosis becomes exostosis.

4. These anatomic processes may be produced experimentally.

5. The repair of compact bone tissue by means of connective tissue is worthy of a place in practical surgery.

6. The external limiting bone layer is an arresting layer interposed between the middle bone bed and the neighboring connective tissue.—*Leo C. Donnelly, Detroit.*

CENTRAL LUXATION OF THE FEMUR OR PELVIC ERUPTION OF THE HEAD OF THE FEMUR. Froelich. (Luxation central du fémur, ou mieux, irruption pelvienne dé la tete fémorale) Rev. d'orthop., Par., 1918, vi 303. Vol. XXVII, June, 1919. No. 6. *Surg. Gyn. and Obst.*

The study of the pathological anatomy shows two of three types of such fractures: Class 1, fractures limited to the bottom of the acetabular cavity without notable fissuring; Class 2, fractures of the bottom of the cavity with fissures radiating to a distance. Class 2 has two types. In one, the femoral head has detached the anterosuperior segment of the cavity and become embedded in the pelvis. The second type of irradiating begins, like the first, by a fissure between the anteroinferior iliac spine and the pectinate eminence but is distinguished from the first by the fact that the superior-anterior segment is involved while in the first type mentioned there is involvement of the inferior-posterior fragment. It is these two types which are the most frequently observed. The obturator nerve is often torn or contused and the vessels in the vicinity, including the iliac vein, may be injured. A fatal hæmorrhage often results. In addition to the nerve and vascular lesions there may be also extensive damage to the pelvic viscera.

The main points in the symptomatology are absolute funtional impotence, flattening of the trochanteric region, external rotation of the lower limb and a slight ascension of the great trochanter above Bryan's line. The distance between the great trochanter and the symphysis pubis is diminished. Concomitant lesions may give rise to special symtoms. The signs of pelvic eruption of the femoral head are shown by radiography and fix the diagnosis.

Treatment consisting in the reduction of the displaced femoral head under chloroform ought to be instituted as early as possible. Different operators use different modes of traction in effecting the reduction.

If reduction cannot be obtained by manipulation, recourse must be had to operation. Froelich believes that the best incision is that which is used for ligature of the external iliac artery as it gives direct access to the bottom of the cotyloid cavity. Traction to maintain the reduction will be necessary for from six weeks to two months. Orthopædic measures for the complications should be used as required.—*Leo C. Donnelly, Detroit.*

NOTES ON GUNSHOT FRACTURES OF THE FEMUR. Massie, R., and Swanson, G. C. *J. Roy. Army M. Corps, Lond.*, 1919, xxxii, 24 Vol. XXVII, June, 1919. No. 6. *Surg. Gyn. and Obst.*

Fractures caused by long range, high velocity bullets are less serious than those caused by ragged projectiles or low velocity bullets. The latter are more common. The highly comminuted fracture is the most frequent type.

In fractures of the upper, middle and lower thirds alike, it has been found best to follow the general idea of extension.

The extending force must be in the direction of the long axis of the upper fragment, with the lower fragment aligned with it.

The medium ring Thomas splint is most useful, except in cases of high buttock or perineal wounds.

A superior method of extension is the application of calipers to the condyles of the femur, except when there are wounds of the lower third of the thigh, in which case there is difficulty in maintaining asepsis.

The caliper points should be introduced through a small puncture wound to obtain a water-tight junction; they should not be sharp and should penetrate the bone not more than 1-16 inch. If uninfected, they may be left in situ for six to ten weeks.

In cases not amenable to extension, internal fixation may be applied by wiring by encirclement, or, in cases of transverse fracture, by wiring a Lane's plate to the opposing ends of the fracture.

Chief among the complications are: (1) Involvement of the knee joint; (2) involvement of the sciatic nerve; (3) gas gangrene; (4) secondary hæmorrhage; (5) comminution, and (6) spreading sepsis.

Spinal anaesthesia or gas and oxygen are the anaesthetics of choice when amputation is necessary. The fall in blood pressure observed during the first ten minutes following spinal anaesthesia is best counteracted by the injection of intravenous saline or citrated blood.

In the treatment of wounds, dependent drainage is preferred to the Carrel-Dakin system.—*Leo C. Donnelly, Detroit.*

PRESENT TREATMENT OF FLAT FEET. S. B. Burk. *U. S. Naval Medical Bulletin,* January, 1919.

Causes of flat feet are constitutional and local.

Predisposing or constitutional causes are shortened tendo achilles, inflammations, traumatisms, etc.

Local causes are knock knees, poorly fitting shoes and other conditions which produce toeing out.

Various exercises are advised for flexible cases, and the operative treatment of the rigid type is spoken of.

EDWARD S. HATCH, M. D., *New Orleans, La.*

FRACTURES OF THE UPPER END OF THE HUMERUS. Stevens, J. H. Ann. Surg., Phila., 1919, lxix, 147. Vol. XXVIII, June, 1919. No. 6. *Surg. Gyn and Obst.*

The author classifies fractures of the upper end of the humerus as follows:

TYPE 1: Fracture of the greater tuberosity without displacement. Subdivision A: With displacement. Both types may be complicated by subcoracoid dislocations. The shaft and neck are both intact.

TYPE 2: Fracture of the neck of the humerus without displacement. Subdivision A: With displacement of fragments, the head remaining in the glenoid.

Subdivision B: Displacement of the head from its relation to the shaft. The head is also dislocated out of the glenoid.

TYPE 3: Fracture of the neck of the humerus with complicating fracture of the shaft of the bone.

Regarding the treatment, the following conclusions are drawn:

1. Fractures of the upper end of the humerus, i. e., above the insertion of the pectoralis major muscle, will in nearly all cases conform to the three types given and three subdivisions. All should be treated in abduction and external rotation, with traction varying from a few days in mild cases to twelve days in complicated cases.

2. Passive motion must be begun early and followed very quickly by active motion to prevent the tendency to restriction of motion. Care should always be used and due regard taken of anatomy and pathology. In the mild cases it is safe to begin motion very early since there is little tendency toward displacement.

3. A right-angled wooden splint in severe cases, and a firm pillow splint in mild cases, with traction, is the ideal method of treatment.

4. External rotation in abduction as a treatment is almost impossible unless the patient remains in bed when it is the simplest method and not uncomfortable.—*Leo C. Donnelly, Detroit.*

THE HISTORICAL DEVELOPMENT OF PUBLIC PROVISION FOR THE DISABLED SOLDIER. McMurtrie, D. C. Interst. M. J., 1919, xxvi, 109. Vol. XXVII, June, 1919. No. 6. *Surg. Gyn. and Obst.*

France was the first European country to establish a home for disabled soldiers. The Hotel des Invalides, established by Louis XIV, was supported by taxation, two, and later three, deniers being levied on every livre spent by the government for military purposes. In the twenty-eight years between 1679 and 1704, 15,000 soldiers applied to this institution for admission. Sisters of Charity cared for the sick. Instruction in a trade, with the necessary tools, was provided by the administration for those interested.

To married inmates permission was granted to visit their families, such permission gradually developing into 3-year leaves on an allowance of not less than 100 livres. Soon the 3-year leaves were extended indefinitely, the allowance automatically becoming pensions, with the result that in 1790, in addition to the 2,370 disabled men in the Hotel, pensions were paid to 26,000 soldiers. Thus in France, the two principles of institutionalism and pensions—principles ultimately adopted by all the western nations—came to exist side by side, and, revised and regulated, were operative when the war of 1914 began.

In England the first steps for the relief of soldiers were taken by Queen Elizabeth for those invalided home from Flanders. During the time of the Commonwealth, Parliament provided for pension grants, hospitals and homes for soldiers, who had been disabled fighting for Cromwell.

In 1682 the Royal Hospital at Chelsea for disabled soldiers which was to

be supported by money compulsorily deducted from the soldiers' pay, was begun. The same year saw the beginning of the Greenwich Hospital for disabled seamen. Both institutions were completed under the rule of William and Mary.

Early in the nineteenth century Parliament passed an act granting pensions to all soldiers who were invalided, disabled or discharged after from fourteen to twenty-one years of service. At the close of the South African war, this system of relief was extended to include widows and orphans of those who died in the service.

No nation hitherto has been so generous in its provision for disabled soldiers as the United States. Plymouth Colony passed its first pension legislation in 1636, other colonies soon taking similar measures. A few months after the beginning of the Revolution, the Continental Congress declared that half pay would be granted every officer, soldier and sailor incapacitated during the war.

In 1792 the first general pension law was enacted, providing for the payment of $5, and later $8, to all privates and non-commissioned officers. This system of relief, with slight revision, continued down to the Civil War. During the Civil War, the principle of fixed rates for specific disabilities was introduced.

In the United States there are now more than 30 soldiers' homes supported by the several states. In some of these the wives, mothers, widows, sisters and daughters of the beneficiaries are also maintained. The inmates of these homes number about 11,000. There are also two Federal institutions caring for between 18,000 and 30,000 men.—*Leo C. Donnelly, Detroit.*

EXPERIENCE GAINED FROM 250 OPERATIONS ON PERIPHERAL NERVES. A Blencke. Zeitschr. f. orthop. Chir. Vol. 38. 1.2, 1918.

The material covers 250 cases with involvement of a total of 311 nerves.

In 4% of the cases there were direct lesions of the nerves which excluded by their intensity any chance of spontaneous restitution. The resection of the nerve was necessary in 161 cases out of 311 that is in more than half of the cases demonstrating the necessity of operative procedure. Bier found a clear severance of the nerves in one-fourth of his operative cases.

The author concurs with Steinthal's indications for operation which are shortly as follows:

1. Motor paralysis with total reaction of degeneration.
2. Partial motor paralysis with total, not improving, reaction of degeneration.
3. Pareses which are growing worse.
4. Grave neuritic symptoms.

Absolute contra-indications are:

1. Suppuration.
2. Pareses which improve.
3. Extensive scar formation.
4. Severe muscle degeneration.
5. Partial paralyses with little functional disturbance.

Of 209 cases with involvement of a single nerve the incidence was as follows:

Musculo spiral involved 97 times.
Sciatic involved 56 times.
Ulnaris involved 31 times.
Median involved 24 times.
Crural involved 1 time.

The musculo spiral was most often injured at its spiral turn and around the humerus. The sciatic shows isolated lesions of the peroneus externus 19 times.

The Ulnar was most often involved at the forearm (19 times), the median at the upper arm (14 times).

Regarding sensory disturbances the injuries to the musculo spiral showed the least symptoms of this kind.

Injuries of the median nerve and of the sciatic showed very frequently trophic disturbances and neuralgic symptoms, the latter most intense in injuries of the sciatic nerve.

Of considerable interest are the author's operative findings. He distinguishes three groups of cases.

In the first group the nerve is entirely intact and there are only mechanical obstacles in the shape of scar tissue of the soft parts and changes of bone which kink or constrict the nerve and in this way constitute an obstacle to the motor conduit. In these cases there were found all degrees from partial paralyses to complete paralyses with complete reaction of degeneration in spite of the fact that the nerve itself was found intact. Very fine strands of scar tissue of the thickness of a silk thread up to extensive films of adhesions, were found as causes of constriction.

In the second group of cases, there was likewise no break in the continuity of the nerve but the scar tissue was not only found surrounding the nerve but was infiltrating the nerve itself, involving the perineural sheaths as well as the endoneural tissue. These perineural scar formations which by constriction interrupt nerve conduction often exceed by long distances the wound canal. For the formation of the endoneural scar tissue the rupture of blood or the lymphatic vessels or inflammatory reactions within the nerves themselves are held responsible.

The third group constitutes the cases of actual, partial or total break in the continuity of the nerve, caused by the projectile or splinters of bone. The nerve in these cases shows the well known changes of neurmma and glimona formations.

The author described at length the technique of nerve suture with a complete enumeration of the instruments to be used.

Post-operative adhesions are best prevented by the use of hardened calf arteries applied as sheaths covering the places of nerve suture. The author had no especially favorable results from the use of Galalith, a case in preparation made pliable by soaking in hot water. Neither does he recommend the use of fascia because of the subsequent shrinking of the latter with constriction of the nerve. Pedicled muscle flap also gives rise to constricting scar tissue if

used as envelopment for the sutured nerve. The use of hardened calf arteries, however, has in the hands of the author always given satisfactory results.

Hardly any exception can be taken to the author's viewpoint that the postulate of Stoffel that corresponding nerve bundles should be brought into exact contact in end to end suturing of nerves is an Utopian idea, impossible of accomplishment in actual practice.

Gaps of the nerve are best handled by proper flexion position of the joints which allow of proper approximation of the ends without tension.

Bridging of nerve defects by nerve flaps and by the pruning method of Hofmeister was carried out in a number of cases but no definite results are reported (nor are they at all likely ever to occur).

In regard to definite results no personal data are given by the author. However, he quotes Guleke, who found good results in twelve cases among twenty-one cases of neurolysis or over 60%, and twenty-six good results or 42% in 62 cases of nerve sutures. Oberdorfer had 72 good results or 22% in 340 cases of nerve sutures. The author had 31% cases of full results in 46 cases of neurolysis but does not give any statistics as to his cases of nerve suture.

He concludes with the somewhat conservative statement that while a number of cases of nerve sutures will show very perfect results and another number remarkable improvement, a vast number of cases will remain unimproved after the end to end suture in which ultimately tendon operations or other methods will have to be applied.—*Arthur Steindler, Iowa City, Iowa.*

THE TREATMENT OF FUNCTIONAL DISABILITY OF THE LIMBS IN A SPECIAL MILITARY SURGICAL HOSPITAL. By Lieut. Wm. Cuthbert Morton, C. B. E., R. A. M. C. Officer in Charge of the Re-education Department of the 2nd Northern General Hospital, Leeds. Vol. VI, April, 1919, No. 24, *The British Journal of Surgery.*

The author fully reports 44 cases, with photographs, of functional disability. Each patient is examined for the first time privately and no one is ever treated in such a way as to lead him to think that his disability is not regarded as a very real thing. It is quite possible to conduct the examination without giving rise to any unfortunate "suggestion."

The patient explains what he cannot do, and is then asked about anything previous or subsequent to the disability which may have any bearing on the case. The limb is examined for oedema, scars, deformities, abnormal postures, involuntary movements, and the like. The movements which the patient cannot voluntarily execute in a perfectly normal manner are noted. The whole limb should be examined in every case, since in drop-foot, for example, the leg and thigh may also be involved so that weakness of abduction at the hip-joint may have caused the pelvis to drop on the other side.

The muscles not functioning properly are noted, with special reference to their condition both when the patient is at rest and also when he is attempting voluntary movement.

It is impossible to believe that every functional disability has been brought on by suggestion; and the man who persists in a functional disability initiated by organic mischief may be no more of a hysteric or a malingerer than the man who remains deaf for some time in the belief that he is incurable, although, when he is at last persuaded to have medical advice, he recovers his hearing completely as soon as the ears are syringed; it was a mistake, stupid perhaps, but no more.

The first problem is diagnosis. How much of the trouble is organic? Is there, or has there ever been, any direct damage to the muscles themselves, to the bones upon which they are designed to act, or to the upper or lower motor neurons by which they should be controlled? Or is it that the tone of the whole muscular system has been so lowered that those muscles which in the course of evolution have been subjected to the greatest strain (as, for example, the peronei, or the abductors of the hip, or the deltoid) can no longer "carry on"? Or is there indirect organic trouble? Is there a reflex (painful or simply protective) causing spasm, or is oedema hampering the muscles (partly by faulty nutrition and removal of by-products, partly by thickening and stiffening of the limb and of the muscles themselves)? Or have the muscles been so long out of action that their sensory mechanism is out of gear? Is there any alteration in the equilibrium of the body, such as a short limb causing pelvic drop and scoliosis, or on the other hand an injury causing scoliosis followed by pelvic uptilt and an apparent shortening of the limb? Is there a loss of the normal muscular antagonism, through a direct injury of the antagonists or their nerves?

In every case a plain statement of the facts and difficulties is made to the patient. If any part of the disability is incurable, he is frankly told so. The rest of the trouble is explained as being due to muscle habit and curable; and as far as possible some period is fixed within which he should be quite cured, whether it be one lesson, one day, one week or one or more months, due emphasis being laid on the fact that, as in full physical training, a great deal depends upon his own efforts. Although the method of treatment may vary according to the nature and site of the disability, yet they are all based upon the same principles—namely, stimulating the muscular sense, restoring the reciprocal action of antagonists, and co-ordinating all the muscles under the unerring control of an educated central nervous system. Each muscle must be taught to function properly, to contract and relax at will, and so, by acting at the proper moment with the proper degree of force, to secure complete co-ordination of all the muscles of the part.—*Leo. Donnelly, Detroit.*

THE DIAGNOSIS AND TREATMENT OF INJURIES TO THE CRUCIAL LIGAMENTS. Smith, S. A. *Brit. J. Surg.*, 1918, VI, 176.

The general treatment of injuries of the crucial ligament should be conservative rather than operative. When the injuries are of long standing operative measures are indicated.

The author's technique is described in detail. He makes a J-shaped incision as for excision of the knee. The patella is divided vertically, and the crucial ligaments exposed and examined. A hole is bored by a one-fourth inch drill

through the internal surface of the external condyle at the site of the upper attachment of the anterior crucial ligament, and emerges at the upper level of the suprapatellar pouch. The internal tuberosity of the tibia is next drilled beginning anterior to the insertion of the sartorius and emerging on the superior articular surface of the tibia just anterior to the internal tubercle of the tibial spine. A strip of fascia lata one and one-half inches wide is now cut, attached at its bottom and about nine to ten inches in length. A flexible probe is pushed through the tibial drill hole and passed through the femur and pulls the fascial strip with it. As much tension as is thought fit is applied to the new ligament and the tibia is forced backward on the femur as much as possible. The free end of the fascial strip is passed through a channel cut for it in the inner condyle, pulled tight and is sutured to the periosteum around the opening in the tibia. The fascia curls as it passes through the bone and makes a ligament about the size of a pencil. The operation is then completed and the wound drained. The limb is kept in a skeleton splint for two weeks, in flexion.

THE TREATMENT OF LITTLE'S DISEASE. Ernset Gasne. *Revue D'Orthopedic*, August, 1918.

The author gives a very thorough synopsis of the different methods in use.

In regard to symptomatology the cerebral and spinal forms must be distinguished. The spinal symptoms consist in paralytic contractures but with decided predominence of the contracture over the paralysis. More often these contractures are generalized or at least very extensive, at the time of birth. But the contractures diminish gradually, releasing first the muscles of the face, neck and trunk. Then come the muscles of the upper extremity so that often, in time, the paralysis becomes limited to the lower extremity, as though the pyramidal tract in its process of regeneration were restoring the short nerve bundles of the upper but not reaching longer bundles for the lower extremities.

In contrast to this, in the cerebral form, there exists aggravation rather than diminution of the symptoms. Under the influence of treatment, however, there are remissions in this type also.

In the majority of cases, therefore, one may note that the syndrome of Little's Disease tends toward spontaneous improvement but that such improvement occurs very much later and is more incomplete in the lower extremities than in the upper.

To this muscular contraction is also added the nutritive shortening of the contracted muscles and the contraction of the fibrous tissues. This is a secondary effect. Whenever muscles become shortened they shrink and become sclerosed. Likewise, with limitation of motion the ligamentous structures of the joint and the peri-articular tissues become also contracted.

There are therefore, two elements in the clinical picture of Little's Disease.

First; contraction which often has a tendency to spontaneous improvement.

Second; retraction, the tendency of which is rather toward aggravation.

The treatment of Little's Disease comprises the following elementary stages:

1. Muscle education.
2. Correction of faulty positions.
3. Orthopaedic operations proper.

1. In regard to muscle education, which consists in massage, mobilization and gymnasium exercises, the point brought out by the author is that these exercises should be given in two sittings daily, especially in the beginning as fatigue appears easily and is likely to cause contraction.

Exercise and massage alone may be sufficient in very mild cases of Little's Disease. While it should be employed in all cases and especially in cases which have not yet reached the operative age, in many other cases it must be followed by redressment or Orthopaedic operation.

2. Redressment of faulty attitude and immobilization.

Such a procedure should be carried out under anesthesia followed by application of cast in hyper-correction.

The time of immobilization given by Lebrun is from ten to twelve days, by Lorenz one to two months, Frölich one to two months, by Calot three months. In fact, the duration of retention of cases will vary with intensity of spasms.

3. Orthopaedic operations.

The most frequent interferences are as follows:

Tenotomy of the tendo-achilles, tenotomy of the ham-strings, tenotomy of the adductors of the thigh and tenotomy of the flexors of the hips. These are all carried out with good result.

In regard to tendon transplantation the indications are very few and results doubtful in spite of good results reported by Hoffa, Codivilla, and others.

Osteotomies are rarely indicated.

In some cases muscle atrophy is such as to make arthrodesis necessary.

In younger children one will use massage and muscle education method. When at operative age, about 7 years according to Kirmisson, redressment and Orthopaedic operation will become necessary in addition. Frölich sets the operative age at 3 to 4 years. In cases of extreme spasticity it would be well to postpone intervention, however, and treat by rest in bed and hot baths for a time.

4. Radicotomie.

In the operation of Förster the sensory roots cut where they emerge from spinal cord if any resection of the spinal column is necessary in order to permit access to the posterior roots.

The Operation of Codivilla—Van Gehuchtens is less severe. There is less of bone resection and less hemorrhage. The roots resected by Förster method are the first and second sacral for contracture of the flexors of the foot, the third and fifth lumbar for the adductors and flexors of the thigh, so that all roots from second lumbar to the second sacral are cut with the exception of the fourth lumbar which supplies extensors of the knee.

In Van Gehucthens method the incomplete resection of the roots is done

but the results seem to be identical with those of Förster. The physiological action of this operation is evident. It destroys not only cutaneous sensibility, but also muscle and joint sensibility. The danger of the operation is that it produces disturbance of equilibrium as well as sensory symptoms. It is up to the post operative treatment to restore function especially as the muscle education is absolutely indispensible after radicotomie.

The Orthopaedic operation proper takes care of the contracture as well as the retraction. The tenotomy especially not only has an influence upon the mechanical position of the joint but also directly upon the muscle tone, which is lessened. Orthopaedic operations also, must be followed by muscle educational treatment.

Following the first operations there was considerable enthusiasm over Förster's method. But after careful study the results published may be summed up as follows:

All cases were improved, the majority considerably. Adductor spasms never recurred but those of the flexors of the knee did. Hunkin says that the results, while good, were less than expected. According to the author the results are in general only partial. They are limited to disappearing of the contracture but muscle re-education must be pushed for a long time on all operative cases. While the spasms and hyperexcitability of reflexes disappear, the re-education of the gait is very difficult. The dangers of the operation are known and do not need any special mention.

Contra-indications are, according to Förster: Cases in which process is progressing; cases of marked idiotism.

In regard to orthopaedic operations proper there is at hand much more experimental and clincal material from reliable observers. A comparison of the Förster's operation with Orthopaedic operations in general shows, that the latter have the advantage of not involving any great risk to the patient. Förster's operation should not be applied except as a last measure in cases resisting ordinary Orthopaedic operations. Biesalski, Frölich, and Broca express themselves in favor of Orthopaedic methods rather than Förster's method. Kirmission will have this method reserved only as a last resort in severe and rebellious cases.—*A. Steindler, M. D., Iowa City, Ia.*

FLAT FOOT. NEW STATEMENT OF OLD TRUTH. L. R. G. Crandon. *U. S. Naval Medical Bulletin*, Jan., 1919.

Flat feet should be treated not as an anatomical, but as a physiological entity. The author does not believe in the use of plates, but advises a shoe with an unstable (rubber, or partly rubber) heel broad outside curves and wide toe to allow a gripping action.

The fact that many men with perfectly serviceable feet though flat have been rejected, and some with weak feet and high longitudinal arches accepted for government service is commented on; and tests by functions and not inspection advised.—*Edward S. Hatch, M. D., New Orleans, La.*